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A Word of Welcome. WE are glad to extend a welcome to the *Electrical Engineer* in its new weekly form. The first number of this journal is now at hand and in its general appearance the paper has not been materially changed, so that, except for its more frequent publication, we perhaps should not speak of it as a new comer. In the great field of electrical industry there ought to be plenty of room for another weekly journal, and the *Engineer* has been so favorably known as a monthly, we feel sure that as a weekly it will continue to merit the high esteem in which it has always been held.

Cobalt Plating. RATHER a new line of electro-plating is that very cleverly discussed in Mr. Watts' paper, published this week. Cobalt is anything but a familiar metal to most people, and its useful application to plating will be a decided novelty. Mr. Watt describes at some length the manipulation of the material, the precautions to be taken in the process and the methods to be followed in finishing the product. The list of metals used for plating purposes is gradually extending, and cobalt certainly possesses some qualities that commend it to the manufacturer, and a commercial demand may considerably cheapen the metal by disclosing new sources of supply. At all events, the new process would seem to be worth a trial, even as a novelty.

An Alleged Consolidation. A RUMOR has lately been going the rounds of the daily press that there was a combination more than contemplated between the Thomson-Houston Company and the Edison Company. We have direct information from an officer of one of the companies—a gentleman who is possessed of every facility for being fully advised of its inner workings—that there is no such combination, and no probability of any such combination occurring. The occasion which may have given rise to the rumor is the fact that the Thomson-Houston Company was contemplating increasing its capital stock.

Electro-Magnetic Radiation. PROF. FITZGERALD'S lecture before the Royal Institution will repay careful reading. The development of the subject is so recent that most electricians have not had an opportunity to study it, but day by day it is becoming of more importance, and unless we are much mistaken we shall wake up some morning and find awaiting us some tremendous practical application of the principle. Even now there are hints of something of the kind, and even the abstruse mathematics in which many of the facts are now hidden should not deter scientific electricians from keeping up with the progress that is being made, or some day they will find that the prizes have fallen to others more industrious in mastering electrical theory.

An Electrical Society for Washington. Evidence of electrical progress and interest in the study of electrical science is every day forthcoming. A correspondent reports from Spokane Falls, Washington, the formation of the Spokane Falls Electrical Society, composed principally of the employés of the Edison Illuminating Company of that city. The society has secured rooms and has arranged for a course of experimental lectures on electrical subjects. They propose to secure a reference library of electrical books, and while not forgetting the social side of the organization, will endeavor to study electricity in its applications, and form the nucleus, perhaps, of an electrical society that may do much good in diffusing a general knowledge of the science.

A New Meter. WE give in this issue a rather complete account of the new Walker electric meter, which we noticed briefly some time since. It belongs to a type of self-registering instruments which has been favorably known in the laboratory, and it is interesting to see it reduced to a simplicity that renders it applicable to commercial conditions. It is, to be sure, not a direct reading meter, but its record for a month could be found very rapidly with a planimeter. It is probable that electricity will more and more be metered as time goes on, so that a satisfactory instrument is highly desirable. For this purpose it should be borne in mind that extreme scientific accuracy is not necessary, but if accurate within one or two per cent., and thoroughly reliable, a meter could do excellent service. We shall watch with considerable interest the commercial performance of this meter, for its laboratory record is good.

Fast Long Distance Telegraphy. THE note from a Paris correspondent published this week, gives some details of the fast work done between London and Rome. The result obtained was specially promising when one considers the fact of there being a cable in the circuit. The difficulties of cable transmission are gradually yielding to continued investigation and experiment, and the possible speed has been steadily rising. It may be that it is too much to hope for to send Morse at any ordinary speed over an Atlantic cable, but it will be strange if within the next few years means is not devised for sending some code at a good rate of speed. Every experiment such as that just performed between London and Rome gives promise of improvement in the methods. In spite of the telephone the telegraph still offers a wide field for invention, and the rewards are still great, for the art of rapid transmission of intelligence is far from having reached the limit of its development.

Iron for Field Magnets. IN another column we give some account of a new motor, in which free use is made of mitis metal for the magnetic circuit. It has been known for some little time that certain kinds of specially prepared cast-iron were possessed of remarkable magnetic properties, or rather that certain irons of high permeability could be successfully cast. A good many private experiments have been made with material of this sort, but as yet it has not come fairly into practical use. The reason of this neglect is probably the high cost, and possibly also a lack of uniformity in the product. The advantages of being able to cast the field magnets without sacrificing the magnetic properties are so apparent that we instinctively look for development along this line. If the mitis metal or any other cast iron of high permeability can be put on the market in uniform quality and at a reasonable price, it ought to come into very extensive use.

Mr. Esson's Paper. THE present issue contains the conclusion of Mr. Esson's valuable contribution to both electrical science and the art of electrical machine designing. It is crowded with information hitherto unpublished, and bristling with practical points up to this time unknown or buried in the private note-books of electricians. If more practical electricians would publish the results of their investigations electrical progress would be swifter even than now. As it is, a very large part of our information comes from England, where practical men have apparently learned that it does not mean commercial disaster to disclose their methods of scientific work. It is to be hoped that such an example as Mr. Esson's will be followed by some of our American experts. They are certainly not behind our English cousins in skill, and the strong prejudice against publication we believe to be without a sound foundation. If evil results were to follow such disclosures they would naturally be supposed to appear in England; but though the competition is very keen, there seems to be as much variety in design and as great a diversity in commercial claims there as here.

Management of Accumulators. IT is with pleasure that we present this week a discussion of this rather neglected subject. More than in any other field, perhaps, has the secretive policy been followed here, and it is positively refreshing to have one so competent as Mr. Pumpelly give to those interested the results of a long and valuable experience. The average electrician has very indistinct ideas or none at all concerning the details to be taken into account in caring for a storage battery plant. These details, however, are of great importance, as it is no difficult thing to inflict serious damage on a storage battery by carelessness in charging or an improper method of forming. It should be remembered that in storage batteries, especially those in which light weight is attempted, mechanical disintegration is the most formidable difficulty that has to be overcome. Of course, when the discharge rate is great, there is a certain amount of heating and other non-reversible action; but the consequent loss of efficiency could be tolerated, did it not shorten the life of the grids. We feel sure that the very practical discussion of the problem by Mr. Pumpelly will be of interest and value to many of our readers, and we trust that other experts in the use of accumulators may be induced to add something to the literature of the subject.

The Tariff on Mica. THE suggestion made in the present tariff bill of putting a duty of 35 per cent. ad valorem on imported mica will be regretted by all electrical interests. For a wide range of electrical manufactures, mica at present knows no substitute, and to meet the increase of electrical manufactures by a tariff on this very necessary sort of raw material seems particularly ungrateful. It is not as if mica mining had been a widespread and important home industry, imperilled by cheap foreign labor, but it has grown to importance only with the growth of electrical manufactures, and now it is hard to see how any fair-minded person can justify taxing electrical manufactures for the benefit of the industry that would have had almost no existence but for them. Mica mining has become profitable very largely through their instrumentality, and in return for this it is suggested to put a prohibitive duty on foreign mica, to increase the profit of a few miners. Until this time it has always been on the free list, and the most exasperating feature of the proposed tariff is, that much of the mica mined in this country is unavailable for electrical purposes, so that levying a duty on foreign mica is not encouraging home industry, but rather putting a deliberate tax on a great and growing branch of manufacture. So far from encouraging, it is discouraging the American producer.

Prof. Thomson's Lecture. ON Wednesday evening, April 2, the lecture room of Columbia College was the scene of a particularly brilliant lecture before the American Institute of Electrical Engineers. Prof. Elihu Thomson, President of the Institute, was the speaker, and his talk on Phenomena of Alternating Current Induction was illustrated by a very beautiful and striking series of experiments, showing the facts very clearly, and incidentally suggesting enough to furnish material for a dozen more lectures. While the phenomena of continuous currents are pretty widely known, most people have a very indistinct idea of the enormous possibilities that are contained in alternating current induction, and almost no idea of the details of the phenomena. Even if the alternating current had no practical application whatsoever, it would be worthy of more study than it has ever yet received, for it is most intimately connected with the immense advances in electrical theory that have startled the scientific world in the last few years. And even more than this do we owe to the alternating current, for its growing use compels the study of electricity as a science. The problems involved in the application of the direct current can be treated by comparatively simple means. But in the immensely more complicated questions involved in the applications of alternating induction a very clear idea of the principles of electricity is needed as a basis of operations. This has little bearing on the practical applications of either system, but it will compel the next generation of electricians to know intimately the parts of the science that are now too often held to be too advanced to be worth learning, and only fit for theoretical dreamers. Such lectures such as Prof. Thomson's, calling attention to the immense field for the application of alternating currents, and setting clearly before the public the intricate phenomena to be dealt with, do a great service to electrical education.

The Walker Electric Meter.

We are now able to give to our readers a full description of the improved Walker meter. This meter belongs to the class of electrical measuring apparatus which furnish a record of the ampère hours, not directly, but in a form fitted for rapid computation. It is, as will be seen from figure (1) which gives a view of the interior of the meter, a practical modification of an old and much esteemed laboratory device, the photographic registration of galvanometer reflections. Photography has long been used for self recording instruments, particularly those designed for furnishing continuous records of magnetic and electric disturbances connected with the earth, and its use has been universally successful. As usually set up, however, the apparatus has been of a rather complicated character. The Walker meter has simply taken this well established method and simplified it for every day use in electrical industry.

The three essential parts of the apparatus are the ammeter, the source of light, and the sensitive film crawling forward at a regular rate to receive the varying indications of the ammeter.

In the instrument as actually made, the ammeter is of the well known class in which a curved solenoid is provided with a curved core of small iron wire, so small as to be practically saturated by a very moderate current. In this particular case the customary pointer attached to the movable core is replaced by a sector, made in this case from blackened aluminum, and provided with a narrow slot through which the light passes and registers its position upon the sensitive film. The movable core is extended so as to form the larger part of a circle, so that when very small currents are passing the core is within both ends of the solenoid. By this device it is possible to make the deflection very closely proportional to the current, so that the ampère scale is a scale of equal parts. The lines indicating the ampères are formed upon the sensitive film by the light gleaming through the series of small holes seen in the figure, which replaces the scale of ordinary ammeters. Each hour the shutter seen below this line of small holes is dropped long enough to register an hour line across the film, and thus the film, when developed, shows two series of equi-distant parallel lines, one of them showing the ampères, the other showing the time, and over this diagram appears the registration line showing the exact amount of current that has passed. The roll of paper is moved regularly forward by the clockwork shown in the back ground of the figure. On the front of this clockwork appears a little electro-motor which each hour is switched into circuit in series with the incandescent lamp within the meter, and the clockwork is thus kept constantly wound to the same point, insuring a regular rate of movement of the film. This rate of movement can be varied within wide limits so as to adapt the meter to all classes of work.

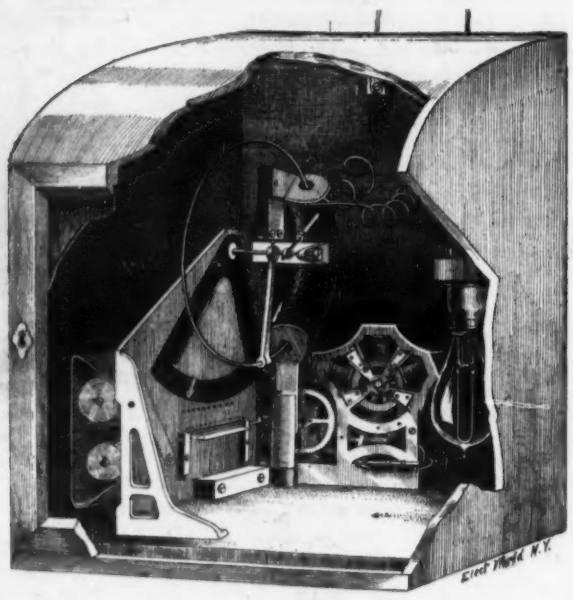


Fig. 1.—Walker Electric Meter—Perspective.

The incandescent lamp within the meter which furnishes light for the registration is of 8 c. p., and is in series with a variable resistance so that the amount of light can be accurately regulated.

The film box, which is shown more in detail in Fig. 2, ordinarily contains a roll of sensitized paper sufficient for a month's registration of the current. At the end of the month the meters are visited by the inspectors like so many gas meters, but, instead of the current consumption being read directly, the films are replaced, and those containing the record taken to the office for computation. Inasmuch as both the hour and the ampère scale are scales of equal parts, the area traced out by the ampère line registered is a correct measure of the ampère hours, and the actual amount of current used can be obtained by measuring this area and multiplying it by a constant, or still better, by running over the area with a planimeter so constructed to include the constant of the meter and give the ampère hours directly. By this latter process the computation of the various amounts registered becomes very simple and can be done with great rapidity.

In Fig. 3 is shown an excellent illustration of the form in which the record appears upon the sensitive film. In the diagram the vertical lines are the hour lines, and the horizontal lines the ampères, while the record appears wandering up and down in the diagram. This record was made specially to show the capability of the meter, and is vastly more irregular than any practical record would be. The dotted lines shown, for instance, were produced by turning out the lamps, one by one, at a rate slow enough to allow each one to register its presence clearly. It is evident from the form of the record that the meter works closely, and is sensitive enough for all practical requirements. Any variation in voltage shows itself in the sinuosities in the ampère line registered. The record taken on this machine will not only give the amount of current used and the time of service, but is a very sensitive detector of any bad administration at the generating station, and any difficulty or carelessness there can be located within a few minutes of the time at which it occurred, when the records are taken to the office to be examined.

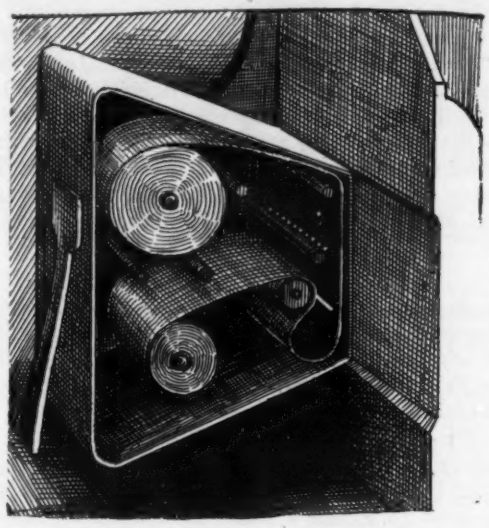


Fig. 2.—Walker Electric Meter—Interior of Film Box.

One important advantage of this type of meter is that the whole amount of current passing into the house is registered in the meter, instead of a known fractional part being diverted and measured, as is frequently the case in electric meters; consequently the energy lost in the meter is very nearly a constant quantity, the current required to operate the meter by means of a single lamp shown being less than the tenth of an ampère. Aside from this constant loss the only other is that due to the heating of the solenoid, which may be made very small.

The errors of this instrument are only those which may be found in any well-constructed ammeter, plus the possible error that may occur from a variation in the rate of the clockwork. By the method of winding adopted, these variations may be made very small. In many of the meters now in use a considerable error may be produced from the fact that an error of the instrument is multiplied by quite a large factor. With a very small amount of current passing, the consumption of energy in this meter is probably equal to or greater than that found in the other well-known types; as the amount of current passing increases, the proportion of loss becomes more and more in favor of the photographic meter.

There seems to be no reason why an instrument of this kind cannot be made thoroughly practical. A careful test of the correctness of the meter has been made by Mr. Geo. B. Prescott, Jr., and the result of his test showed, as might have been anticipated from the construction of the instrument, that the record of ampères would not vary perceptibly from that given by a good standard ammeter. As the instrument is nearly frictionless and as no strain is put on the working parts, it should be easy enough to make it thoroughly reliable. It should be noted that the instrument is quite nearly dead-beat, so that on the current being changed the needle takes up its new position with very slight vibration, little or no record of which appears on the sensitized film. Of course the final test of the adaptability of any meter to practical use is putting it in operation on a large scale, but the instrument we are discussing seems to be accurate and practical, and unless experience should show that some part of the mechanism is unreliable, it certainly seems to be admirably adapted to the uses to which an electrometer is ordinarily put. It can readily be fitted for use with an alternating current, although the type at present made is suited for continuous currents only.

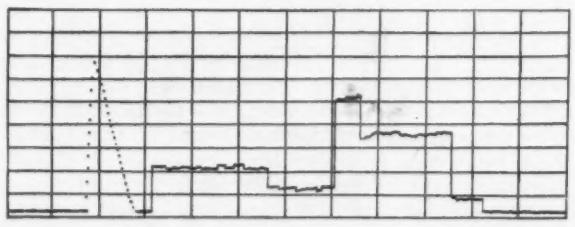


Fig. 3.—Walker Electric Meter—Fac Simile of Record.

Testimonial to Mr. M. D. Law.

When it was known that Mr. Law had tendered his resignation as superintendent of the electric light companies of Philadelphia, the employés determined to present him a token of esteem that would show him their appreciation of his many years of labor with them as employer, instructor and friend. During his long term of superintendent they could remember only acts of kindness, patient toil in instructing, and constant words of friendship. They remembered the monthly meetings, where he answered all perplexing questions, solved all difficulties, and gave such good practical advice; showing each one how the work should be done, and explaining why it should be done in the manner prescribed, that each man felt a personal interest in his own line of duty, and an *esprit du corps* was maintained that has placed Philadelphia at the head in electric lighting.

The testimonial took the form of an engrossed copy of resolutions passed at a meeting of the employés, on March 10, and a gold badge of unique and beautiful design.

The employés all assembled at the Brush station on Sunday, March 30, and by a clever ruse Mr. Law was decoyed there at the same time and escorted to the room.

Mr. Thomas Flannery, one of the oldest employés, and chief of the construction corps, in making the presentation, said:

"I have been delegated by the employés of the different stations which have been under your care, to present you with these testimonials of their esteem in acknowledgement of the many kindnesses they have received at your hands. In presenting these to you I but voice the sentiments of all, in wishing you a continuance of the success which has crowned your efforts among us. And in regretfully bidding you farewell, we one and all sincerely hope that when among new found friends you will not forget the many old ones left behind. With the best wishes for your future welfare, we once more bid you farewell."

Mr. Law was for a moment unable to speak, but recovering himself, in a voice full of emotion, he thanked them for the mark of friendship, for their steadfast loyalty to him, their earnest co-operation with him, and his pride that they had by their work contributed so much to the success of the companies. He spoke of the danger of their work, and for the last time instructed them how to lessen the danger and avoid accidents. In conclusion, he said, "Last night I was tendered a banquet by some of my friends in Philadelphia, and was presented with an album, and by the directors of the company with a gold watch. While I value these very highly, yet these testimonials coming from you have a value all their own, which I shall cherish while life lasts." Mr. A. J. De Camp, the general manager, said, "In losing Mr. Law we have lost a good superintendent, and you a good friend. An evidence of his judicious management is shown in the fact that he has welded the jarring interests of the different stations into a homogeneous whole, all working for the common good; and it is a matter of congratulation that he has so imbued you with his own spirit of loyalty and devotion to duty, that whoever may be his successor will find a well-trained and disciplined corps of assistants."

As the meeting adjourned, all crowded around Mr. Law wishing him God-speed and good-by:

At a meeting of the employés of the electric light companies of Philadelphia held March 10, 1890, the following resolutions were unanimously adopted:

Whereas, We, the undersigned employés, believing that we represent the feeling and sentiment of those connected with this department, respectfully presenting this token of our esteem and regard to Myron D. Law, Esq., who for nine years has filled the position of general superintendent, and by his uniform kindness has endeared himself to all, we do hereby express our sincere regret at his withdrawal from the companies which he has so long and faithfully served; therefore, be it

Resolved, That while we regret being compelled to sever the tie which has so long existed between us, we cherish the hope that the future life of Myron D. Law, Esq., may be one of unbroken prosperity and happiness.

Resolved, That we present him with an engrossed copy of the above resolutions.

W. J. Flannery, Chairman.

C. G. Chusman,
J. J. MacNamara,
D. S. Frame,
Robt. Morehouse,
J. Rosner,
} Committee.

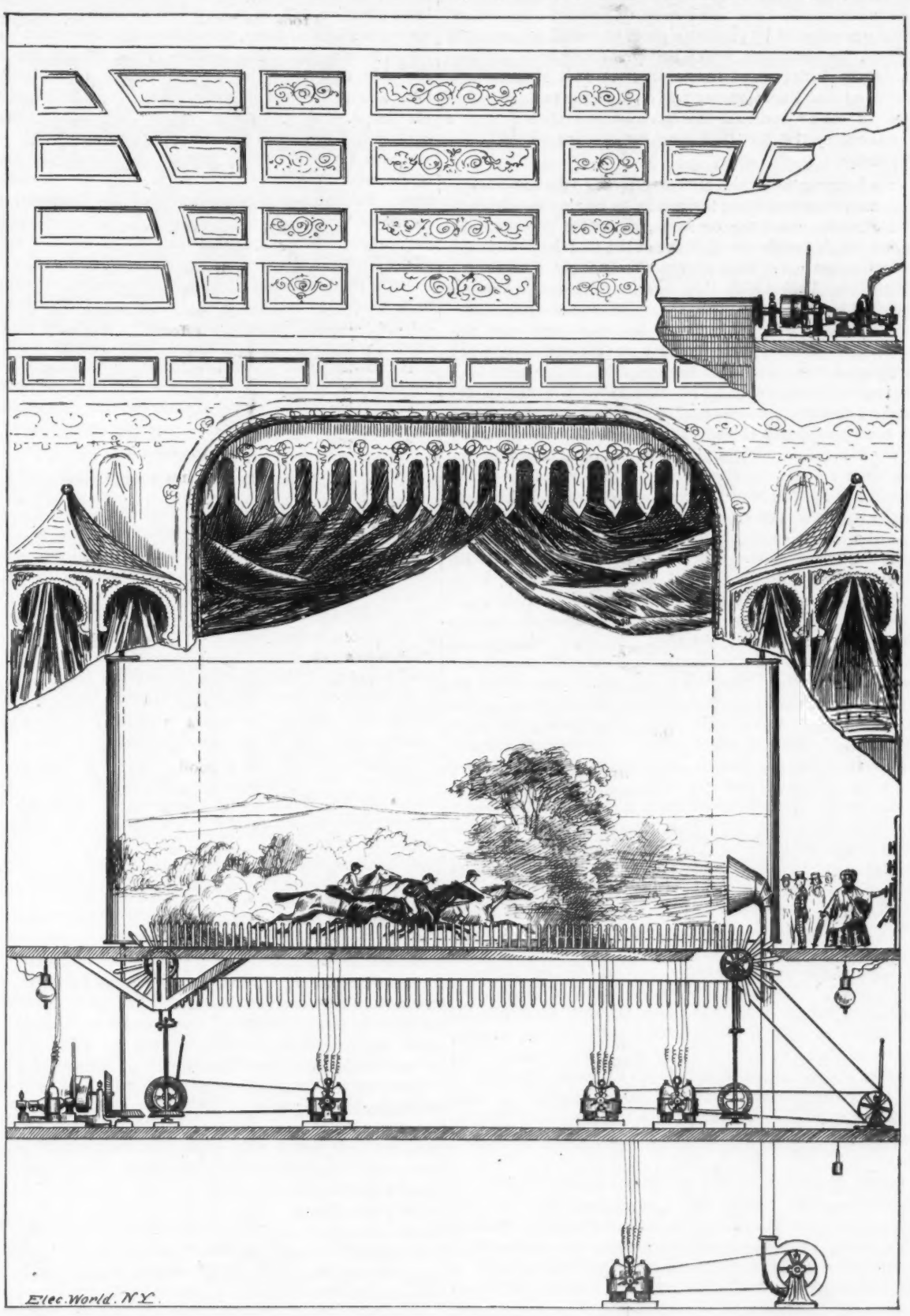
Wm. Cannon, Secretary.

Astonishing the Natives.

An amusing account comes from New Guinea relating the effect upon the natives when the s.s. "Nelson" exercised her power. The foghorn was blown, and the electric projectors flashed upon the village. The natives thought the two electric lights to be the eyes of some great monster, and when they heard the sound of the siren they immediately concluded that it was the voice of the monster, and, acting under this belief, numbers of them ran away and hid in the bush in terror of their lives.

Electricity Behind the Stage.

Those who have seen Mr. Neil Burgess' in that clever and popular play, "The County Fair," at the Union Square Theatre, have been surprised and delighted at the novel effects obtained in the last act, where a horse race is represented with a fidelity to nature rarely attained on the stage. The effect is really wonderful. The electric lights in the theatre are flashed out, and after a few moments of inky blackness the flying horses appear at the back of the stage in a blaze of light. They seem to be straining every nerve, and fairly flying past a varied landcape. Fences and trees disappear behind them with startling rapidity, and when at last the finish is near one of the horses gradually works forward, winner by a neck as he approaches the judges' stand; then an instant of darkness, and in the flash of light that follows the horses are pulled up beyond the stand, and the race is won.



ELECTRICAL DEVICES IN "THE COUNTY FAIR" AT THE UNION SQUARE THEATRE.

Through the courtesy of Mr. Burgess, who devised the apparatus, we are enabled to give a detailed account of the very ingenious mechanism by which this decidedly remarkable effect is obtained, and it will be specially interesting to our readers as the electric light and electric motor play a very prominent part in the scene.

Our cut shows a section of the stage and the mechanism below it. As will be seen, the picket fence behind which the horses appear to be running, and the varied scenery that is beyond, are both set in motion by the judicious application of the electric motor, and both form endless belts which move at the same speed past the horses, producing the effect of rapid motion of the animals in a contrary direction. The fence in the foreground, running over flanged wheels specially adapted for the purpose, has guides that hold it rigidly perpendicular during its passage over the stage.

At the close of the third act the large screws, shown in the figure, are set in motion, and lift the working mechanism of the play up to the level of the floor which had previously covered it. Three flexible endless platforms passing over rollers at the sides of the stage, serve to complete the illusion by enabling the horses to be in rapid motion without actually moving forward. In fact, so far from moving forward, they are secured by wire rope traces.

At the proper time, as the race nears the finish, the platform on which the winning horse is stationed is gradually slipped forward on a track provided for the purpose until the finish, the actual movement being of course only a few feet. The space between the fence and the scenery behind is 14 feet, giving ample room for free action of the horses. Much of the effect of the scene is due to the extreme suddenness with which the electric lights can be flashed off and on, throwing the stage from extreme darkness to brilliant light and back again in an instant, so that the whole scene appears as a vivid panorama before the audience.

A switchboard on the stage, left, enables one man to control the lights and the mechanism by which the scene is given, and this is in part the reason why electricity has been used so freely. Mr. Burgess himself is enthusiastic on the stage applications of electricity, feeling that by the use of electric motors the whole mechanism of a complicated play can be put under the control of a single man, and manipulated with such facility and rapidity as to very much reduce the waits between acts, and entirely obviate any of the exasperating hitches which otherwise might sometimes occur. He proposes to still further increase the application of motors to his stage setting, and so arrange things that in so far as possible, all mechanical devices and movable scenery, curtains and the like, will be handled by motors from one point with great rapidity, and without the danger of trouble from careless attendants. As a matter of fact, Mr. Burgess usually manipulates the switchboard himself during the last act, as the effects are produced while he is off the stage. He is much interested in things electrical, and proposes during the coming summer to provide himself with an electric launch for his amusement at his summer home, a boat about 25 or 30 feet long, propelled by an electric motor, after the style of the electric boats which have come into some little use on the Thames, near London, but as yet are hardly known in this country. The result of this coming experiment will be watched with interest, as an electrical boat on a practical scale will be rather a novelty hereabouts.

The electrical equipment of "The County Fair" is changing with great rapidity, and as improvements suggest themselves they are promptly applied. Although there has been recently some difficulty in getting sufficient electric lights for the theatre, we may confidently and constantly expect that electricity will be given a fair chance to show its adaptability to the varied requirements of the theatre. If by its use it should prove possible to obliterate completely the long intervals between acts which in so many theatres are a nuisance, it will be a change for the better which will be enjoyed by all theatre goers.

We have devoted some little space to the description of this apparatus because it is employed to produce really very remarkable effects, the illusion being enough to deceive even the most hardened mechanician, and because Mr. Burgess' interest in electricity will probably lead to great improvements in stage mechanism.

Some Experiments in Telegraphy.

A Paris correspondent sends the following interesting account of rapid telegraphy over a long distance: Some months ago there was arranged a direct telegraphic communication between London and Rome, working on the Hughes system, with relays at Paris, Lyons, Turin and Florence. Its operation since then has been very regular, although accidental disarrangements have been somewhat more frequent upon this line, 2,200 kilimetres long, than upon other shorter lines.

Recently experiments have been tried on this line with Wheatstone apparatus, with relays at Paris, Lyons, and Turin. It has been possible to secure 120 words a minute between London and Rome, and this speed evidently could be surpassed if the fourth relay was used at Florence so as to divide the Turin-Rome section, which is about 840 kilimetres long, into two parts. There is no doubt that a speed of transmission of 200 words a minute would be reached, since this speed has been attained upon the London-Paris section. The repeaters which have been installed at Paris and Lyons are of the latest post-office model, and allow of working either a simple or duplex instrument. The arrangements are necessarily very complicated. There was one of these instruments in the Exposition in Elliott's exhibit, precisely similar to that established at Lyons. The repeater at Paris is still more complicated by reason of the cable which necessitates a series of condensers to allow for its capacity. No trials of duplex telegraphy have as yet been made between London and Rome, but experiments have been made between London and Marseilles in the course of which 90 words in each direction have been successfully transmitted. The experiment has not been repeated, but it certainly did not give the maximum speed it is possible to attain.

A Successful Dynamo Telegraph Plant.

The dynamo plant of the Western Union Company at Albanv, N. Y., which has been in operation since July, 1889, displacing 7,000 cells of Calland battery, has greatly improved the service. The arrangement is somewhat different from that in New York, Pittsburgh and Chicago.

The plant, which is located in the Edison Light Station, two blocks distant from the telegraph office, consists of nine Edison dynamos—three of each polarity for regular service, and three spares arranged to supply either polarity, driven by a 7½ h. p. electric motor.

Each potential is furnished by an independent machine, the first of 90 volts, the second 150 volts, the third 250 volts. All the dynamos are wound to generate currents of higher potential and are driven at a slow speed as a matter of economy. Three potentials are found to be sufficient for all the main battery service. Artificial resistance is added to the city wires and loops and other short wires, so that the 90-volt current can be used with perfect success.

Duplicates of every part of the plant, both electric and steam, are so arranged that instantaneous changes can be made without interrupting the service.

The currents are carried to the telegraph office in an aerial cable. There is also a spare cable between the station and the office on an entirely different route. An independent plant has been installed at an intermediate point on the route of the spare cable, for use in case of serious accident or interruption at the regular station. The spare cable connects the telegraph office with both stations.

The independent plant consists of two dynamos generating one current of each polarity at a potential of 250 volts. This is used to replace the highest potential sent out from the regular station, and supplies the quadruplexes. By

means of rheostats this current is cut down to meet the requirements of the other circuits.

In no branch of the service has the improvement caused by the adoption of the dynamo current been more marked than in the Gold and Stock Ticker system. The dynamo current is also used to run a Sprague motor in the office, operating the pneumatic tube and copying press. The plant was designed and installed by Mr. Alonzo Beatty, of New York. Negotiations are pending for the addition of machines to supply the local circuits.

Electro-Magnetic Radiation.*

BY PROF. G. F. FITZGERALD, M. A., F. R. S.

The professor began by explaining how small forces, if repeated at regular intervals so as to give rise to a series of rhythmic impulses, might be made to produce great and destructive effects. By suitably selecting the period of vibration so as to agree with one of the periods of vibration of any body, these rhythmic impulses might be made to exert destructive effects on that body; and, on the other hand, damage to any given structure might be avoided by selecting periods to which it was incapable of responding. This principle, that certain bodies or structures were capable of absorbing periodic impulses of certain definite periods, being thrown by them into very intense vibration, was known as the principle of resonance. Professor Lodge, in a lecture on "The Leyden Jar," delivered at the Institution last year, had arranged his apparatus so as to make the period of the alternating discharge as great as possible, in order that each wave might be separately distinguishable. The lecturer then proceeded to explain that for waves in any given medium, which in case of Professor Lodge's and his own experiments was the ether, the wave length was inversely proportional to the vibration period. The length of the waves in Professor Lodge's experiments was about 600 miles.

Ether waves which would produce the highest audible note would have a length of five or six miles, but what he required for making the presence of electro-magnetic vibration visible, was a wave length of from two or three, up to ten or twelve feet. The period corresponding to this would be about the hundred millionth of a second. Waves giving the highest audible note would take about three hours to make as many vibrations as these would in a second, and the waves in Professor Lodge's experiments would take about a fortnight.

The lecturer then exhibited a large Hertz oscillator which was to be employed in setting the electro-magnetic vibrations.

This consisted of a pair of large metallic plates suspended from the ends of a long glass rod. From the near sides of the plates projected wires terminating in brass balls, the distance between which was capable of being varied by sliding the plates along the rods. The two plates were then connected with the terminals of a Ruhmkorff induction coil, and sparking set up between them. The indicator employed to detect the presence of electrical oscillations consisted of a long conductor of copper wire, having its ends furnished with brass knobs, and brought sufficiently close together to allow sparking to take place between them when electrical oscillations were set up in the wire by the ether waves radiating from the oscillator.

The lecturer then explained the nature of the circumstances which determined the period of electrical oscillation by comparing with the vibrations of a tuning-fork. The vibration period of a tuning-fork could be diminished either by increasing the stiffness of the prongs, or by diminishing their mass, and, similarly, the period of an electrical oscillation could be diminished by diminishing the capacity of the conductor in which the oscillations took place, or by diminishing the air space across which sparking occurred: a small electrical capacity in the conductor corresponding to stiff prongs in the fork, and a small air space corresponding to small mass in the prongs. The sparks in the secondary circuit or detector were too minute to be seen at a distance; but the lecturer was able to indicate their existence to the audience by means of the discovery which he had recently made, that if the air-space terminals were connected through a delicate galvanometer, the galvanometer was deflected whenever sparking occurred across the air space. He had not at present succeeded in arriving at any satisfactory explanation of this phenomenon, but it afforded a convenient means of demonstrating the existence of the sparks to an audience. The lecturer explained that it would not do to connect the terminals of the secondary circuit, or resonator, as he called it, through the galvanometer, as if that were done no sparking would take place. He therefore had to adopt an arrangement in which a small subsidiary spark was given across an air space with its terminals connected in this manner.

It was then shown that when the length of the secondary circuit was doubled the sparks became smaller, which was indicated by the diminution in the disturbance of the galvanometer. This result was in contradiction to all the theories of electro-magnetism, with the exception of the Faraday-Maxwell theory, that electro-magnetic disturbances were propagated by ether waves. According to this theory it was to be explained as due to diminished resonance, the resonator in the first case having, so to speak, been turned into synchronism with the oscillator, and the addition of a greater length of wire to the resonator throwing it out of synchronism. The lecturer then illustrated the principle of interference of vibrations, by communicating vibrations of large amplitude to the free end of a cord suspended from the roof, and showing, in the first place, that the wave, after traveling up the cord, was reflected on reaching the fixed end, and traveled down the end again. He then agitated the lower end of the cord rapidly and regularly, upon which it separated into segments separated by points of rest, or nodes, and the centres of which were points of maximum amplitude of vibration or loops. This was explained to be due to the interference of the direct and reflected waves. The fixed end of the cord, or point of reflection, was a node, and the lecturer showed that similarly the point of reflection of an electro-magnetic wave was a node, or point of no vibration. This was effected by placing a sheet of metal immediately behind the resonator, which had previously been sparking under the influence of the oscillator. This reflected the waves so that the resonator was close to the point of reflection of each wave, and this position was shown to be a nodal one by the fact that sparking at once ceased in the resonator.

The lecturer then referred to Hertz's fundamental experiment demonstrating the existence of a series of points of maximum sparking or loops, separated by equal distances, each double the distance of the first loop from the reflecting surface. This proved conclusively that electro-magnetic radiation took time for its propogation, as was required by Maxwell's theory.

The lecturer then again threw the suspended cord into vibration, but this time by moving its free end rapidly in a horizontal circle instead of backwards and forwards in a horizontal straight line. This gave to each point of the cord a combined motion of oscillation and rotation which he compared to the electric and magnetic forces respectively in an electro-magnetic vibration, observing that the magnetic and electric forces, like the rotary and oscillatory motions of the points of the cord, were invariably at right angles to each other. It was then pointed out that in the case of a single wave travelling along the cord the crest of the wave or point of maximum displacement was also the point of maximum rotation, while in the case of a series of direct and reflected waves in rapid succession the nodes, or points of no displacement, became the points of greatest rotation. It was exactly the same in the case of the electric and magnetic forces, the two attaining their maximum and minimum values together at a distance from the oscillator; that is to say, in the case of a single wave, while near the oscillator; that is, in the case of series of waves surging backwards and forwards, the magnetic force is a maximum when the electric force is a minimum, and *vice versâ*.

The lecturer then observed that Maxwell had deduced from his theory that light is an electro-magnetic disturbance propagated through the ether, the conclusion that sunlight ought to repel any body which either absorbed or reflected it. The effect, if it existed, would be exceedingly small, which was probably the reason that it had not as yet been possible to detect it; but a similar effect could be observed by suspending a metallic conductor in front of a powerful electro-magnet excited by an alternating current. The conductor absorbed part of the electro-magnetic radiation falling upon it, and also reflected a portion, so that it ought to be repelled by the magnet. This was shown to be the case by suspending a half-crown with a mirror attached to indicate its motions in front of an electro-magnet excited by an alternating current from a dynamo in the basement of the Institution. The coin was seen to be repelled as soon as the current was turned on.

Referring to the nature of the ether, or medium by which electro-magnetic waves are transmitted, the lecturer pointed out that it could not be of the nature of a solid, because rotation could not possibly continue for any long time in the same direction in a solid body; and in the case of the transmission of electro-magnetic waves, continuous rotation of the transmitting medium could go on for hours at a time.

The fact that electro-magnetic rotation obeys the same laws of reflection as the other forms of radiation known to us, viz., light, heat and sound, was demonstrated by placing a small oscillator with its air space on the focal line of a vertical metallic parabolic cylinder, and a resonator in the same horizontal plane on the focal line of a second metallic parabolic cylinder, having a common axial plane with the former one. The resonator was then seen to respond to the sparking of the oscillator, although the distance was too great for it to have done so without the intervention of the mirrors, and merely by the action of the waves transmitted directly. A wooden frame with a number of parallel wires stretched upon it was then interposed between the two mirrors, perpendicular to their common axial plane. It was then found that as the frame was rotated, still keeping it perpendicular to this plane, a position could be found in which the resonator would not respond to the oscillator, but when turned through a right angle it produced no effect, the waves traversing it without hindrance. Now, this framework would absorb electro-magnetic vibrations parallel to the wires, but no those at right angles, so that the experiment was analogous to the inter-position of a plate of sclenium, the path of a beam of polarised light, and showed that the electro-magnetic vibrations were polarised, that is to say, were all parallel to one plane.

The growth of the electric and magnetic force was then illustrated by a series of diagrams, which were first thrown upon the screen in slow succession, and then made to follow one another with great rapidity by means of a kind zoetropic apparatus, designed by the lecturer, thus illustrating in a very striking manner the nature of a series of electro-magnetic waves.

Returning to the consideration of the nature of the medium by which electro-magnetic waves are propagated, the author exhibited the following beautiful and striking experiment, in order to show that a vortex in a liquid could be thrown into vibration exactly as if it were a solid. A large glass jar, full of water, was provided, with a small aperture at the bottom, through which the water was allowed to run out. The lecturer then opened the tap at the body, and threw the whole mass of liquid into rotation about a vertical axis by stirring it round with his hand. A columnar vortex was thus formed, extended from the top to the bottom of the water, and was made visible by throwing some quinine into the liquid, and illuminating by a beam from an electric lantern. The jar was then shaken and the beautiful fluorescent vortex was seen to pulsate just like an elastic solid, the waves traveling up and down between the two surfaces of the liquid from each of which they were reflected. The lecturer then suggested that the ether might be supposed to be a liquid containing a number of vortices of this kind, for Sir William Thomson had shown the possibility of the existence in a liquid of stable columnar vortices with their axes inclined at all possible angles. Vortex rings threading between these stable vortices would represent material atoms. This theory would explain all the phenomena of nature as being due to different movements in space.

*Abstract of a lecture delivered at the Royal Institution, March 21.

A New Scheme for Cheap Power.

In his paper read before the French Academy of Science, M. Ch. Tellier claims to be able to produce motive power for .44 pounds of coal per horse-power hour. This result is obtained by using a combustible gas, employing the heat generated by its explosion to generate steam, and the use of the vapor of ammonia. When the gas has operated on the piston it escapes at a temperature of about 400 degrees into a generator where steam is produced, which is used to act upon the opposite side of the piston from the gases. There are two advantages claimed for this—the high temperature due to combustion of the gas prevents cylinder condensation, and the steam assists in lubrication. The completed machine for which this claim is made will consist of two cylinders, one making its forward stroke under the action of the explosive gases, and its return stroke by the action of steam; the other is operated entirely by vapor of ammonia. Under these conditions, says M. Tellier, there can be no doubt theoretically or practically that .44 pounds of coal per horse-power hour is an economy which can be secured.

Electric Enterprises in Massachusetts.

Some interesting figures are given in the fifth annual report of the Board of Gas and Electric Light Commissioners of Massachusetts. Authoritative figures are very hard to get on electrical subjects, and the information contained in this report will be studied with unusual interest.

Fully $5,000,000 are invested in electric light companies in Massachusetts, most of the total stock being held by residents of the State. The total amount of dividends was over $170,000, being $3\frac{54}{100}$ per cent. of the total capitalization of the companies doing business. The highest dividend paid by any company was 21 per cent., which included an extra dividend of 15 per cent. On the 30th of June last there were in use for electric light purposes by incorporated companies, 358 dynamos, driven by 199 engines aggregating 18,812 h. p. Water wheels were used to the amount of 545 h. p. A single company used 45 h. p. gas engines. These figures, of course, do not include the isolated plants, but only the central stations. These electric light companies have in use 14,412,043 feet of wire, 100,263 feet of conduit, and 330,196 feet of underground wire. All the underground wire which is returned is in the cities of Boston, Fall River, Lawrence, New Bedford and Springfield. No returns are given of underground wires of Brockton, Mass.

The number of single carbon arc lamps in use is 5,463; double carbon arc lamps, 3,375. Something over 3,000,000 carbons were used during the course of the year, two-thirds of them being copper plated; 538 motors were in use, aggregating 1,442 h. p.—of these, 111 were on arc circuits, 379 on incandescent circuits, and 48 on Faure circuits.

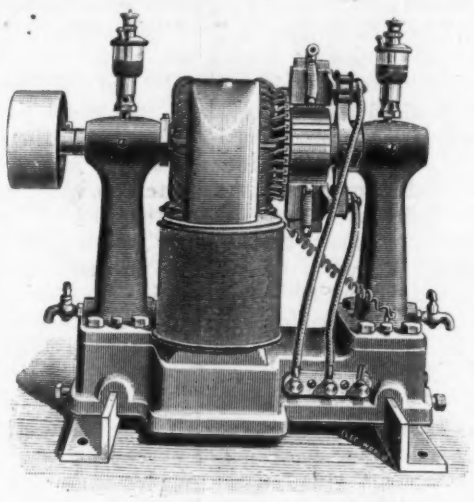
Reports from incandescent lighting show a total number of lamps furnished from incandescent circuits at 72,406, nearly all of them being 16 c. p. lamps. In addition 2,438 incandescent lights were furnished for commercial purposes off arc-light circuits. These lamps were of various candle power, the largest number being 16 c. p. lamps, although the more powerful series lamps were quite numerous.

Of course these figures do not represent the total of the State by a considerable margin, for there are very many private plants, and undoubtedly these would aggregate a very respectable amount.

The report contains a vast amount of interesting information concerning the companies which do business in the State, and is worth a careful examination by any one specially interested in the condition of the electrical industry.

The McDougall Motor.

We present herewith a cut of a new motor which soon will be pushed into public notice. It is designed by Mr. W. M. McDougall, well known from his long association with



THE MCDOUGALL MOTOR.

the Edison Company and Mr. Daft in his motor experiments. As will be seen, the motor is of the well-known inverted horse-shoe type, with a Gramme armature. To secure high efficiency there are some devices for keeping down the magnetic leakage, so that the loss from this cause is practically very small indeed, there being hardly any perceptible magnetism in the frame of the machine. Of course there is likely to be less leakage in the inverted form than in the type of machine where the poles have to be in close proximity to the bed plate, and in this motor even the small loss which naturally takes place is still further lessened by the method of attaching the base plate.

The really novel points of the motor are two—first, the use of a Gramme armature of peculiar construction, and second, the general use of mitis metal for the magnetic circuit. It has been known for some time among electricians that it is possible to secure an iron having nearly or quite the magnetic properties of fine forgings, and which yet may be cast. It is strange that no more use has been made of such material, although its expense has probably acted as a deterrent in many cases. Recent experiments in Germany have shown that it is possible to secure a cast iron of even better magnetic properties than most wrought iron, and experiments tried on the mitis metal of which this motor is constructed have shown a similar result. Not only is it equal in magnetic permeability to forgings, but many specimens of it are distinctly better—in some cases by as much as 50 per cent. These valuable properties make mitis metal likely to take an important place in electrical manufactures, for the ability to avoid expensive tool work by making casts of material magnetically so good will go far toward compensating the extra expense. The Gramme ring of the armature is thoroughly laminated, and is supported on a bronze spider grasping the laminated part of the armature between rings of the same Mitis metal of which the magnets are made. Mr. McDougall has now one of his motors running as a dynamo and charging a novel type of storage battery with which he is experimenting. This battery is said to stand very heavy charging, although it probably does so at the expense of weight and efficiency, as might be expected. He has also experimented with a modification of the alkaline storage battery, but as yet with little success. He has now under construction a large motor of the type just described, for street car service, in connection with storage batteries, a machine to develop 30 h. p. with a total weight of about 1,800 lbs. Its construction is similar to the stationary motor shown, except, ot course, for the arrangement of the bed plate. A Pacinotti ring will probably be used with this machine to lessen the magnetic resistance of the circuit. The motor will be wound for about 185 volts, and modifications of speed will be obtained by a change in the grouping of the storage batteries, and also changes of gearing in the motor. The motor is, as is usually the case, geared down twice to the car axle, and a single motor only will be used on each car. It is expected that the motor will be completed and the car ready for experiment in four or five weeks.

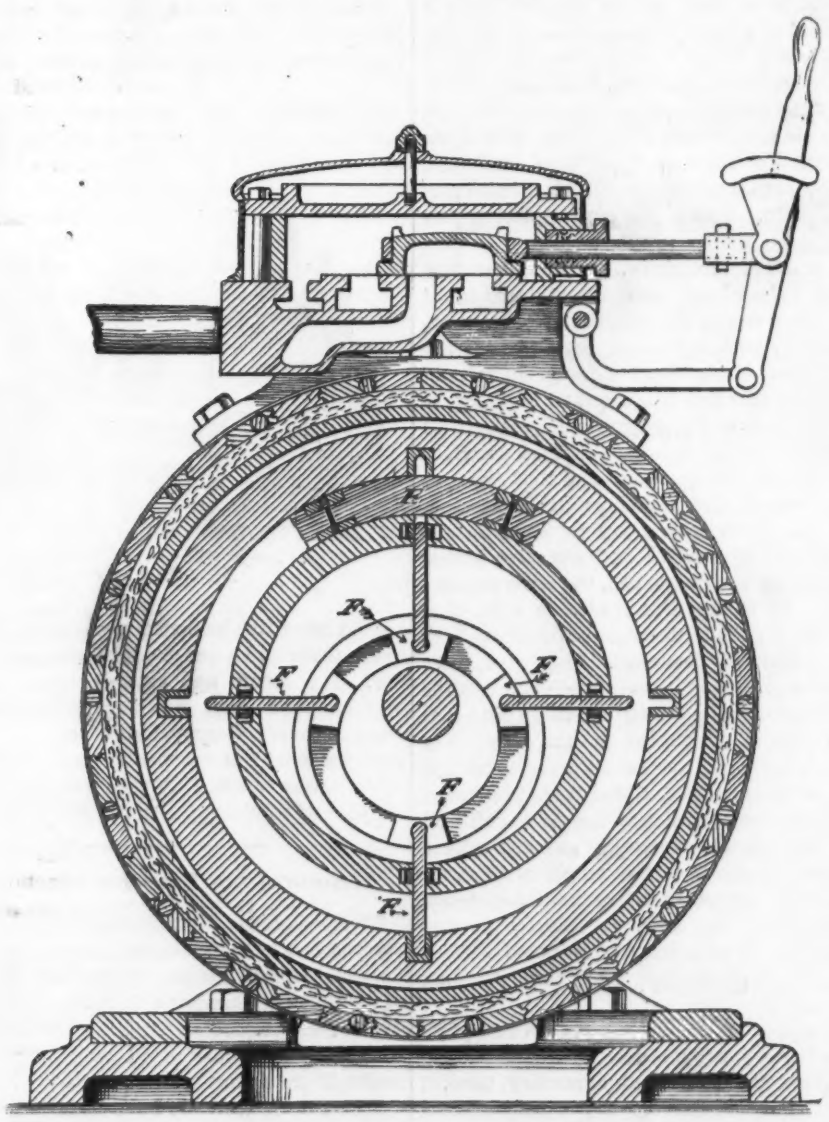
We should not have called so much attention to it were it not for the interesting results that have been obtained by using cast iron of the character mentioned. As may be seen from our cut the amount of metal required is rather mall.

A Gloomy View of Artificial Illumination.

One of our English contemporaries publishes the following dismal discussion of our methods of lighting. It is at least consoling to know that the use of electricity may help the matter: What is a serious consideration for us is the dirt we create—mechanical and chemical—by our modes of illuminating our rooms. I need not enlarge on the harm gas does to us—our books, our pictures, our bronzes—the damage cries aloud, and is clamant in our ears. The electric light would seem to be a palliation to this—not so complete as it appears at first sight, for it will take, I suppose, as much coal to light us electrically as it does at present gaseously. Only the products of its combustion will be distributed differently, and dispersed into the air at a limited number of centres, instead of at each gas tap, but how they will behave when they leave the chimney of the station, we have yet to discover. At present our own smoke in great measure stays with us. For mechanical reasons, in its presentment, the law of diffusion of gases refuses to work, and our smoke-cloud's nature is to remain stationary over us, sluggish and heavy. The rains beat it down into our gutters in part, but not wholly. It is only after a hailstorm, or an exceptionally violent fall of rain, that our streets are clear. In our own created atmosphere we live as in a jelly of isinglass, tinted to an ashy opalescence, for the cloud of smoke and vapor yields and sways to the wind, but does not retire. The wind passes over its upper surfaces in its failure to dislodge or penetrate it, and carries only before it the lighter and less tenacious streamers at the top. These rags of filth keep their coherence far more greatly than steam, or the clouds of the upper air, and their languor is as marked as their pollution. Our new electric lighting stations may increase the altitude of our gelatine dome, and so doing diminish our shortened measure of sunlight, but that they will tend to lessen the misty scum in which we move and have our—asthma—is a hope too dear for us to cherish.

A Duplex Rotary Engine.

Many of the rotary engines heretofore brought out, have not proved as economical in the consumption of steam as was desirable, and their field of operation has been limited. To overcome this defect, and to produce a rotary engine that would prove of value for all classes of work requiring a high-speed movement, three Chicago gentlemen devised the duplex rotary engine that has been in practical operation at the Chicago Exposition building for some time, and which is pronounced by experts to be a commercial success and an engine well adapted for the operation of dynamos. The sectional view of this engine is shown herewith; the inside wheel represents the cylinder, *E* being the stationary abutment, relatively the same as the head of the piston engine; *F*, the pistons or cut-off operated by a stationary cam that moves them out and in when under the stationary abutment. As shown, the steam chest containing the slide valve is on top of the engine, and the flow is controlled by a lever permitting the steam to enter the engine on both sides alike, equalizing the pressure. The steam passes completely around the chamber found on the inside wheel, and is as cleanly and distinctly cut off by the four pistons as in a straight-line piston engine. In fact, the inventors claim that it is a piston engine having a rotary movement.



DUPLEX ROTARY ENGINE.

The engine was devised by Jos. S. Kiehl, F. Meyer, and A. Grant, who are respectively the president, treasurer, and manager of The Duplex Rotary Engine Company, of Chicago.

The Management of Accumulators.

BY J. K. PUMPELLY.

To those who wish to handle accumulators, to form them properly, and to charge and discharge them for every day practical use, the writer, who has learned what he knows by hard experience and many disappointments, will in this article give some idea of what the work is and what it must be.

Let us put aside all theories, only understanding enough to make what we do successful. In the first place, we must take it for granted that the care and advantages of location, and a certain amount of scientific knowledge, can produce from a laboratory test with a storage battery more favorable results and a greater per cent. of efficiency than could probably be obtained from the everyday work to which most accumulators are subjected.

Having a number of plates made for the purpose, the process of setting them up for charging and forming is simple enough. It is taken for granted that some knowledge of the make-up of a storage battery is known to those who may be interested in this article, hence, we will speak of a storage battery as a collection of lead plates or grids, coated over or filled in with oxide of lead, such as common red lead and litharge; the litharge, which is a slightly different oxide, chemically, than the red lead, is generally used as the negative plate in the battery, and red lead as the positive. These plates are placed in a cell or case, composed of some material that will resist the corroding and disintegrating action of strong acids, facing each other and never over a quarter of an inch apart, the reason for which will be given later on. Then one less than one-half of the number are connected by means of conducting material, such as lead or copper, well insulated and protected from the action of acid fumes, as the positive plates and the remaining plates, connected in the same way, form the negative pole; these plates being carefully placed and so separated from each other by strips of non-conducting material, that no local action can occur.

The electrolyte consists of water and sulphuric acid, generally eight parts of water to one part acid. When the mixture is first made it becomes very hot, hence it should not be made in a glass vessel. The acid must be poured gradually into the water and constantly stirred

not the water into the acid, and the liquid must not be used for several hours or until cool, and is then poured into the cell until it completely surrounds and covers all that portion of the plates which are made to be acted upon, even reaching above that point an inch.

The batteries being thus prepared, and supposing we have a number of them arranged for convenience in a row, the negative poles are all connected together, and the positive in the same way. Then, in order to charge them, this negative pole connection is attached to the negative pole of the dynamo, and when the dynamo has reached its full speed, the positive poles are connected in the same way to the positive of the dynamo. This is readily accomplished by the use of a switch. Now, as we are ready, and while the current is passing through the battery, we will give our readers and experimenters some idea of how we are to decide upon the proper current and electromotive force necessary for charging. "How and Why" is learned from actual experience and chemical knowledge.

Accumulators do not store electricity, as we understand the word. We are dealing with what must go for comparative expressions. The change that any sufficient current of electricity passing through and then out of the battery produces in the battery is an electro-plating action, and while this electro-plating process between the positive and negative plates is going on, an element of energy is being held therein, which, when set free, performs a certain amount of work, and this difference between this energy, used up, to produce the necessary chemical change, and the amount of work we get out of the battery, is called the difference of potential. Even this expression, "difference of potential," may be crude, and advanced science may find other expressions and other meanings for the cause of this energy.

A current of electricity of a known quantity, called ampères, driven by a known pressure, called volts, when passed or driven through the electrolyte which surrounds the plates of a storage battery will produce a chemical change in some part of the liquid. Exactly what it does, as far as we know, is to decompose the water, setting free oxygen and hydrogen, of which water is composed. The oxygen always goes to the positive pole or side of the battery, and the hydrogen to the negative. When the oxygen reaches the oxide of lead on the positive plate it changes it from an oxide which contains a small amount of oxygen to one now containing more oxygen; in fact, it makes a peroxide of lead of it, and the hydrogen goes to the negative side of the battery, and is evidently absorbed. At the same time some oxygen must have been driven out of the litharge, which is a still lower oxide of lead than the red lead, and the actual metallic lead, in minute particles, is left on this plate. This is the electro-plating process spoken of.

Now, while this is done, electricity, or an element of energy which becomes electricity, is seemingly stored in the two sets of plates. Now comes the calculation, that is approximately correct, by which we can regulate our dynamo, to give the proper electro-motive force, in volts of pressure, and say, three ampères of current will decompose a certain amount of water, and hydrogen and oxygen set free by this current will change a certain estimated surface of lead oxide. Strangely enough, it is found that the moment these plates are insulated and grouped together in a cell in which the electrolyte is confined, and these individual groups consist of positive and negative plates, each group by themselves in a case or cell, the same pressure or voltage will not be sufficient for all the cells; that would do for one cell, but the same amount of current or ampères will be a measure for them all. Thus it takes a little over two volts of pressure to charge each cell, but the same flow or movement of ampères for one as for all—that is, the pressure in volts is multiplied by the number of cells to be charged, but the current in ampères needed is calculated by the extent of surface of lead oxide to be acted upon in one cell, that is, by the size of the single cell; for instance, $2\frac{3}{10}$ volts will charge a battery of one cell with a current of ten ampères for a certain length of time, according to its size, but a current of $2\frac{3}{10}$ volts will not charge a battery of ten cells; but if the volts are increased—that is, the pressure raised to 23 volts and ten ampères, all the cells will be charged in the same time, providing they are all of a size.

Supposing that a current of two volts and five ampères would set free, in a battery, oxygen and hydrogen enough in one hour to convert one square inch of surface, then, if continued ten hours, it would convert fifty square inches. If our battery plates contained 500 square inches of surface, we need not take 100 hours for the process of converting or charging, but use a current of fifty ampères for ten hours. It can now be seen that a battery made up of a certain number of plates, of a certain known size, can be charged with a current large enough to charge in a convenient number of hours. So plates of large surface can be charged with a current of many ampères. Thus, having a dynamo that will give a large current, a large battery can be charged as quickly as a small one using a small current.

To sum up, if a number of plates, each of the same chemical surface, were added together, it would give us an approximate idea of the amount of chemical surface that each plate can be acted upon. If $2\frac{3}{10}$ volts of E. M. F. and 25 ampères will produce a certain amount of chemical change every hour on each plate, and the plates are large enough to endure a change equal to an efficiency of 100 ampères, then this current of 25 ampères must be forced through the cells four hours, and if we find, as experience teaches us, that there is a loss of, say, 14 per cent., in counting this stored efficiency, then we must continue the charge somewhat longer.

To form new battery plates so that they may be most efficient, we find that a thirty hours' charge is necessary to complete the change in the negative plates, and nearly three times as long to produce the proper change in the positive plate. The manner in which this is done will be explained further on.

(To be continued.)

The Rechniewski Dynamo.

Are the field magnets laminated? is by no means an infrequent question when talking about dynamos. M. Rechniewski believes in a thorough lamination of his pole-pieces, and so would a good many constructors if they could overcome the prejudice against increased cost of construction. A machine, and especially a dynamo, is, and must be, a compromise between theory and practical construction. A more perfect machine may be designed, but it will not pay to produce it, and to such a perfection is the "efficiency" of the machine carried by the best constructors, that the question of "more in accord with theory" is met with the reply, it won't pay. There is little to be said of the Rechniewski machine, except that he uses laminated field-magnet cores instead of solid cast or wrought-iron cores. The armature is practically a Siemens armature. The Société l'Eclairage Electrique constructs these machines in various standard types, to give from 150 to 120,000 watts. The output per weight is one h. p. for from 55 pounds to 65 pounds, according to the size. The efficiency claimed is from 88 to 95 per cent., and, as we say, the sole question is whether this efficiency is greater than that of non-laminated machines—in fact, so much greater to warrant the extra cost in building, as the sheets have to be insulated and the whole connected.

A New Feed Pump.

Herewith we give a cut of a very neat small duplex feed pump which has recently been brought out by the well known firm of Dean Bros., of Indianapolis. The pump

New Dean Steam Pump.

shown has a five-inch steam cylinder of five inches stroke and a three and a quarter inch plunger in the pump cylinder. The levers and stuffing boxes are made of brass, which secures good wearing properties, and the plunger works through deep packing rings of hard bronze. The entire machine is compactly and carefully built, as for such severe service as feed pumps it should be. The simple and solid design commends itself.

Improved Arc Lamp for Incandescent Circuits.

The desirability of an arc-light service with incandescent conditions has been long recognized, and the need does not decrease as time passes. There have been many attempts at adapting arc lamps to incandescent circuits with varying degrees of success, the great difficulty having been the fluctuations of current in such lamps when burning on multiple arc circuits.

This trouble seems to have been largely overcome in the improved arc lamp that is now being made by the Electrical Construction and Supply Company, 18 Cortlandt street, the lamp burning evenly on a nearly constant current, giving a clear, steady light, and being adaptable to incandescent circuits of any continuous current system. These lamps can be used on such circuits in connection with incandescent lamps and motors without affecting any part of the system, as the current consumed by the arc lamp is practically constant. In order to secure this uniformity of current, the resistance of the arc has to be maintained very evenly. Each lamp is provided with an automatic cut-out, which perfectly controls the current under all conditions, and an individual switch, so that the lamps are easily trimmed. The mechanical parts of the lamp are simple in construction, the feed is strong and reliable, the controlling and cut-out magnets are highly insulated, and every precaution has been taken to produce a lamp requiring the least possible repair. It is adapted to use eight ampères when burning two in series across 110 volts, and is also run two in series on any constant potential direct current circuit of from 100 to 125 when burning a 45-volt arc. It can be run more in series where the voltage is proportionately higher; its field is constantly increasing, and it is designed to make lamps for constant potential circuits of any known voltage in practical use.

Practical Hints on Cobalt Plating.*

BY ALEXANDER WATT.

Since cobalt as a coating for other metals, as brass, copper, and steel, for instance, presents some advantages which would render cobalting a useful substitute for nickel plating, I have lately made a series of experimental trials with a view to point out as far as possible the most favorable conditions under which successful and uniform results may be obtained in the deposition of this metal for practical purposes. Cobalt, being a whiter metal than nickel, would be a useful coating for ornamental brasswork, as also for small fancy articles in which a cheap, white, metallic film is desirable. Being softer than nickel, articles coated with cobalt may readily be brightened by burnishing, a process that could not advantageously be applied to nickel-plated surfaces. Like nickel, cobalt is a non-oxidisable metal, and therefore retains its color in ordinary atmospheres. Although cobalt is a dearer metal than nickel, I am disposed to think that its employment as a substitute for the latter metal would not in the long run greatly exceed, if at all, that of nickel-plating, and for the following reasons: Only one-third of the quantity of "salts" are required to make up a bath; about one-third of the anode surface is required; the deposited metal, being softer than nickel, naturally requires less labor in finishing; and, finally, less current is required than for nickel. Taking, therefore, these points into consideration, they will probably be found to balance those in favor of the cheaper metal. As to the difference in value of the respective metals when actually deposited upon the work done, this might probably be counterbalanced by extra charges for the cobalted articles, which might reasonably be demanded so long as the cobalting remained a novelty.

In making up a bath the salts employed were the double sulphates of cobalt and ammonia, this compound being practically the most suitable for commercial purposes; and in order to ascertain the proper density at which the bath should be prepared, solutions of various densities were tried, and the one which appeared to yield the best results was selected. The next point to determine was the density of current which would give a perfectly adherent deposit of good color, and free from "burning" at the corners of a flat plate or projecting surfaces of an article. After making many modifications in the strength of the solution it was found that a bath of the specific gravity of 1,015 (water being 1,000) at 60 degrees Fahr. gave the best results, and this was obtained by dissolving $4\frac{1}{2}$ ounces of the double sulphates of cobalt and ammonia in one gallon of water. This solution worked most favorably with a current of about .800 ampère, the E. M. F. being about two volts. The electrodes used in the first trials were a well-cleaned brass plate 3 inches by 2 inches for the cathode, while the anode consisted of a plate of rolled cobalt supplied by Messrs. Henry Wiggin & Co., of Birmingham, from whom also the cobalt salts were obtained. The next point to determine was the amount of anode surface which was necessary to admit of a prompt deposit, and yet not too quick for an adherent film. With the current named, and about equal electrode surface, it was found necessary, after a few minutes immersion of the brass cathode, to remove a considerable portion of the anode from the bath, in consequence of the plate becoming blackened or "burnt," as it is termed, at the corners; when the surface of the anode was reduced to about one-third that of the brass plate deposition took place with perfect uniformity, and there was no longer the least tendency to the discoloration referred to. It thus became evident that an important consideration in the electro-deposition of cobalt is the amount of anode surface which is most suitable in a cobalt bath of a given density. In nickel-plating, as is well known, this is not a matter of so much importance, and it is commonly the practice to employ a very large surface of anodes in the baths, almost regardless of the actual surface presented by the articles suspended in the solution. My object in directing special attention to this difference between the operations of cobalting and nickel-plating is, that I believe that one of the reasons why the electro-deposition of cobalt has not been successful in some hands is that too little attention has been paid to the detail I have pointed out.

To prepare a solution bath for cobalt plating, $4\frac{1}{2}$ ounces of the crystals of double sulphate of nickel and ammonium for each gallon of the bath should be dissolved in hot water, and the solution then made up to the required quantity by the necessary addition of cold water. The solution should then have a specific gravity of about 1,015 at the temperature of 60 degrees Fahr. For the successful deposition of cobalt upon articles formed of brass, copper, steel, or iron, the anodes may be of rolled cobalt, in narrow strips say about two inches wide and 12 inches to 18 inches

‡ From *The Electrical Engineer*, London.

long, according to the size of the depositing-tank. The anodes should be placed about six inches apart along the sides of the tank, and in the case of large tanks, say, vessels holding 200 or 300 gallons or more, a corresponding series of anodes should be suspended from a conducting rod placed lengthwise, and resting on the ends of the tank, as in nickel-plating, etc. All work to be coated with cobalt should be polished and prepared for the solution precisely in the same way as for nickel-plating, and before they are immersed in the bath the current must be so regulated that the work may become coated with a film of metal, or "struck," as it is termed, within a few seconds after being placed in the bath. There need be no fear of the work stripping—provided it has been properly potashed and scoured—if the articles become coated immediately after immersion, but in this case the current must be at once reduced, otherwise the work is sure to "burn," or become discolored, at certain parts in a few minutes after. It is far preferable, indeed, necessary, after the first film has been obtained, to immediately diminish the current, this being again augmented when other articles are put into the bath. By watching the rate at which each article becomes coated and regulating the current accordingly, the probability of burning the work will be readily overcome. My reason for directing special attention to this is that cobalt deposits so much more readily than nickel that any person unacquainted with the deposition of cobalt, and treating it as he would nickel, might naturally fall into error, readily avoided, which would cause failure and disappointment. It should always be the rule, therefore, in cobalt plating to diminish the current so soon as the article is fairly coated all over, but more especially is this the case when the work becomes coated instantly after immersion. Since copper does not appear to receive a deposit of cobalt quite so readily as brass with the same amount of current, it will be found advisable, when copper articles are to be cobalted, to start with a somewhat stronger current than would be required for the yellow alloy, but when the piece of work has fairly struck all over with the stronger current, this must afterwards be reduced somewhat during the remainder of the time the article is in the bath. In cases where a dead cobalt surface is required the articles, having been dipped in the usual way, may be scoured with powdered pumice, or still better, with powdered Bath brick, and after rinsing placed in the bath, using a rather strong current at first, and reducing it after the work is coated all over. If such articles have projecting points these must not be allowed to approach too close to the anodes, otherwise such parts will be apt to become dark; should such be the case at any time, however, the piece of work must be removed and again scoured at the discolored spot and then rinsed and returned to the bath, a weaker current being used. All dead work, after removal from the bath, should be plunged into clean boiling water and allowed to dry spontaneously, care being taken not to handle the work at such parts as will be required to present a clean, white surface. When a brighter surface is required, the work may be scratch-brushed at the lathe, with brushes made from fine steel wire, moistened with beer in the usual way, after which the pieces may be dipped in a solution of cyanide of potassium, and finally rinsed in boiling water and then put into clean box sawdust. Buttons and other small fancy brass articles may be treated in this way.

In depositing cobalt upon steel or iron surfaces a much weaker current is required than for either brass or copper. The current from a single Daniell cell is amply sufficient for coating small steel articles, and, since cobalt adheres very firmly to this metal, it will be found useful for imparting a white coating to many articles formed of steel or iron. It is also important to note that steel articles coated with cobalt may be brightened by ordinary burnishing, for, as before observed, cobalt is softer than nickel and yields very readily to the pressure of the burnisher. When depositing cobalt upon cast iron, a rather strong current must be used to secure an immediate coating after the work has been placed in the bath, after which, as before, the strength must be diminished and sustained at a uniform density until a sufficiently stout coating is obtained. Here, again, it is necessary to point out that projecting surfaces must be kept as far away from the anode as possible, so that those portions may not become discolored or "burnt" and necessitate re-scouring.

There is another feature in cobalt depositing which presents an advantage over nickeling which it is well to mention, namely, that when it is found necessary from any cause to rescour a piece of work and return it to the bath until finished, the operator need not fear, I believe, that the work will be liable to strip after the second coat has been given, for I have generally found that brass and even steel surfaces may be frequently rescoured and cobalted again and again without the metal stripping in the least degree. In the case of nickel we all know that the deposition of film upon film of this metal is almost invariably succeeded by the second coating separating from its predecessor. It may be further remarked that the rescouring of the work, to produce an improved surface upon a defective film, can scarcely be applied to a nickel-plated article, owing to the extreme hardness of the metal. With respect to cobalt, however, the case is different, for with good brisk brushing with pumice, silver sand, or Bath brick reduced to a powder, I have found no difficulty in producing the surface necessary for a satisfactory deposit of the metal when, from various causes, it was found necessary to repeatedly rescour the plates used in the experimental trials referred to. In no instance, however, did the subsequent layers of cobalt strip or peel off the metal already deposited.

Some attempts were made to deposit cobalt upon zinc from the double sulphate solution, but in each instance it was found that the film was non-adherent, except in portions of surface where partial adhesion of the metals occurred. Although there are some other solutions of cobalt than the above which would be more suitable for cobalting zinc, it is somewhat doubtful whether a really good deposit of cobalt on this metal could be obtained with any degree of certainty.

In working the solution prepared from the double sulphates of cobalt and ammonium, it appears to be necessary to maintain the liquid at as uniform a density as possible, and for several reasons. For instance, if the bath be allowed to acquire a higher density than about 1015, by the spontaneous evaporation of a portion of its water, the color of the deposit will probably become affected, and a darker tone imparted to the articles instead of a tolerably good white characteristic of electrolytic cobalt when deposited under more favorable conditions. To obviate such a defect in the metallic strength of the bath, the hydrometer should be floated in the liquid at least once a week, especially in warm weather; and whenever the solution indicates a higher density than it originally had, an addition of water must be made until the specific gravity has been reduced to the proper figure. These additions of water, however, should be made in the evening, or when the bath is not being used, and the solution must be well stirred, and then allowed to rest for at least 12 hours. It is also necessary to avoid adding an excess of water, since a solution much weaker than that indicated will be apt to cause the deposit to be patchy, and certain parts of the article may for a time refuse to receive the deposit. These observations are based upon results actually obtained under the conditions referred to, but the defects may readily be avoided by adopting the precautions suggested.

Respecting what is understood as the *color* of the deposit, this is greatly influenced by the strength and tension of the current. For instance, it is perfectly easy to obtain films of cobalt upon brass surfaces with an E. M. F. of one volt and a large surface of anode, but this deposit will not be so white as when the current has an E. M. F. of two volts, with small anode surface—that is, about two-thirds less than that of the cathode, or article to be coated.

With respect to the purposes to which cobalting is most applicable, these may be taken as being, on the whole, as similar to those for which nickel-plating is adopted, but, like the latter metal, it should never be applied to culinary or drinking vessels, since it is, like nickel, readily acted upon and stained by vegetable acids, as vinegar, for example, beer, and also by vegetable infusions, such as tea, the water in which cabbages have been boiled, and other liquors of a similar nature. Cobalt also resembles nickel in becoming dull when long exposed to damp atmospheres, and should not, therefore, be employed for articles which are required for out-of-door ornamentation, unless the surfaces can be persistently rubbed over with a dry leather every day. On the other hand, cobalt plating may be adopted for any class of art-metal work which is destined to remain in ordinary dry apartments, as fenders, fire-irons, etc., or for ornamental work to be worn on the person. Mullers, sausage warmers, dental instruments, and cast brasswork, such as lavatory taps and so forth, may be advantageously coated with cobalt, the articles being prepared and finished as before observed precisely in the same way as in nickel plating.

Battery Lighting.

Electric lighting by means of batteries is an ever-fascinating subject for inventors, and the pet scheme is to be able to sell the waste products, and so have the light for next to nothing. There is another of these schemes, this time hailing from France, which has the claim of a certain amount of originality. This is a single-fluid battery introduced by M. Pollak. It has no porous pot, and contains a plate of zinc as negative electrode, and a plate of lead as positive, with a solution of sulphate of copper as exciting liquid. The zinc is dissolved and the copper is deposited on the lead, the latter remaining inactive. The electrodes of the standard types are made to last for a fortnight, but the maker takes them back in exchange for new ones, the copper paying for the zinc, so that the sulphate of copper is the only expense. Every day a few crystals of sulphate are placed in a trough above the battery, and the water is regulated so that the overflow runs into an automatic circuit-breaker. A suitable number of accumulators are connected with this circuit-breaker separately. This apparatus is composed of a movable receptacle, turning on an horizontal axis, which turns over when full of water. A system of movable contacts puts the battery successively into communication with one of the accumulators at each movement of the circuit-breaker. The lamps are supplied directly from the accumulators, which the battery is constantly charging. A Pollak battery of seven elements and eight small accumulators corresponds to 15 lamp hours of 8 c. p., and the cost of maintenance is given as about 2d. per candle hour.

An Engine for Naval Lighting.

To obviate the slackness of work in the dead season, the English Naval authorities have introduced at the dockyard factory at Portsmouth considerable extensions in the manufacturing plant. Among the most interesting machines turned out, the most important are some singularly beautiful and novel engines which have been designed and constructed in the yard for driving the dynamos for producing the electric light. These are the first made, and are of an entirely new character. Two will be supplied to the "Rupert" and three are for use in the yard. Instead of being boxed up, and consequently inaccessible, they are entirely open. They are of the compound tandem type, the high pressure cylinder being placed on the top of the low-pressure cylinder. They are to be driven with steam at 100 pounds pressure, and with 380 revolutions, which is considerably under the usual number; they are expected to indicate 65 horses, which is estimated to be equal to 400 ampères and 80 volts. The bearing surfaces are made large in order to remove all risks of heating, and to prevent all danger of fracture the exhaust pipe from the high to the low-pressure cylinder is fitted with a gland which admits of a reasonable amount of expansion. Racing, caused by a number of lights being simultaneously switched out of gear, is prevented by spirally-fitted governors, by the sensitive action of which the revolutions cannot by any possibility leap up more than 10, after which they almost instantaneously revert to the normal. Perfect lubrication, both as regards the steam in the cylinders and the moving parts of the engines, is effected by means of a common tank and a number of separate copper pipes, without the use of the usual oil can.

Dangers of Fire from Different Systems of Lighting.

An interesting report comes from London, dealing with the statistics of fires in that city, and showing the number of fires that can be directly traced to various methods of lighting. The figures for the last three years are interesting food for reflection. They are as follows:

	1887.	1888.	1889.	Totals.
Candles	142	113	136	391
Gas	188	197	209	594
Lamps	245	205	257	707
Electricity	0	1	2	3

The figures are remarkable, and although, of course, electricity is not in as extensive use as the other lighting agents, the fact that it has caused only three fires in three years shows that it is not an exceedingly dangerous method of domestic lighting. The destructive lamp does its work as thoroughly, it would seem, in England as it does in this country, and it would be hard indeed to find a report from any American city showing the same number of fires caused by candles. It is not, perhaps, fair to make any malanimadversions on our English cousins, but it would seem as though electricity could replace certain mediæval methods of lighting with a very marked increase in safety.

Electricity at the Lenox Lyceum.

The electrical exhibition at the Lenox Lyceum, advance mention of which was made in these columns in the issue of March 22, was thrown open to the public on Monday evening, April 7. The attendance was large, and many well known men and women were present, including Mr. Edison, in whose honor a reception was given the first evening. Professor Brackett, of Princeton, delivered the opening address. The exhibition, as previously stated, is for the benefit and under the auspices of the Exchange for Woman's Work, and is to continue for six weeks. It has many interesting and novel features, and will well repay a visit.

The main hall is occupied by the telegraphic, telephonic and physical apparatus exhibited by Mr. Edison at the Paris Exposition. In the centre of the hall, rising to the height of 25 feet, is a column covered with myriads of small colored incandescent lamps, and from the top of the column extend streamers thickly strung with hundreds of miniature colored incandescent lamps. The streamers give one an idea of the festive May-pole, with its gorgeous ribbons, but are infinitely more brilliant and dazzling. They are fastened to the balcony all about the hall, forming a gay and beautiful canopy for the lower floor of the hall. The walls in this room are hung with a fine collection of water color drawings and diagrams, together with a number of photographs of Mr. Edison's apparatus and of his experiments. At the entrance stands a beautifully modeled figure of Benjamin Franklin with his kite, and on either side a profusion of tropical plants and floral decorations.

The stage represents a Hungarian garden in which the Florentine serenaders, seven pretty Italian girls, nightly delight the audience with carefully chosen selections. Just below on a terrace is a Hungarian orchestra, which also does its part toward the entertainment of the audience. The combined effect of electric light, floral decorations,

music and gaily dressed people gives an extremely brilliant and pleasing effect.

The American Bell Telephone Company has gone to great trouble and expense in its arrangements, by which, with the permission of Messrs. Abbey and Grau, of the Grand Italian Opera Company, Mlles. Patti and Albani and Signor Tamagno may be heard over the telephone while singing on the stage of the Metropolitan Opera House. Mr. Aronson has also given permission of a similar telephonic connection with the Casino, by which the members of that excellent company can be heard by the visitors.

The Long Distance Telephone Company have made elaborate arrangements for exhibiting their instruments and entertaining the public. The Phonographic Toy Manufacturing Company has erected a very unique doll's auditorium, where half-hourly recitals are given. A mysterious chamber has been arranged, in which skeletons and electric effects delight the visitors.

A miniature electric railroad, with electric lights, a tunnel, switches and every possible feature connected with an ordinary railroad, is represented on a small scale. The cars on this tiny road run day and night, and are very cleverly manipulated.

One very large room is devoted to glimpses of the 20th century. Here a stage has been erected, and fitted with luxurious furniture and scenery. The scene represents a bachelor's quarters as it is supposed it will look in the 20th century, fitted with all the modern appliances of that day, in their perfection—loud-speaking telephones, phonographs in connection with the clock to announce the hour, and like, gorgeous arrangements of electric lights, magic lantern effects by electricity, electric organ and piano, pneumatic tube connections, and so on. The Woman's Exchange have procured in connection with their dining rooms a large collection of fine pictures in oil and water colors. One of the main features of the exhibition is the large and well arranged display of Mr. Edison's phonographs, where reproductions of music on all kinds of instruments, reproductions of the voice, both talking and singing, can be heard under the most favorable circumstances, as the instruments are manipulated by experts from the Edison laboratory.

There are numerous other electric effects, too numerous, in fact, to describe, so that those who can attend ought not to miss the opportunity of visiting the exhibition before it closes, May 15.

Primary Batteries.

A correspondent sends us the following interesting note on his experience with primary batteries for lighting:

To the Editor of The Electrical World:

Dear Sir: I have been running in my own house electric lights from a primary battery advertised in your columns for several months, and for the light I require I am running as cheaply as with gas. I am most thoroughly pleased with the light it gives and the simplicity with which the batteries may be recharged. I feel confident that this primary battery for lighting and small power is not an expensive luxury, but a safe and practical method.

Very sincerely yours, W. T. Knox, Electrician.

[There is no reason why a primary battery may not be used with advantage for light and power in cases where the amount is so small that the expense is not at all formidable, but we fear that our correspondent would hardly find it economical in lighting, for example, his whole house, particularly if he were not an electrician and able to give the plant expert care. We should fail of our duty to our readers if we did not extend this warning comment, and add that we uniformly close our advertising columns to the electrical Phœnix to which we alluded in our last issue.—Ed. E. W.]

Mr. F. W. Best, of Denver, Colo., stopped over in Chicago one day last week en route West from New York.

The Rose Electric Light Supply Company, St. Louis, have kindly favored this office with a handsomely framed photograph of their display at the late exposition in St. Louis.

The Standard Electrical Works, Cincinnati, are having an excellent trade in their special monogram iron box bell, while the demand for Okonite wires continues as heavy as heretofore.

Col. J. H. Shay, of the Charles Munson Belting Company, Chicago, has returned from a Western trip, during which he had several encounters with cyclones, savages and salesmen, but came out with flying colors.

A New Station.—The consolidated electric lighting companies in Memphis have secured a convenient piece of ground 193 x 292 feet on Beal street running back to the Memphis & Charleston Railway tracks, where new station buildings similar in pattern to the structures at Salem, Mass., will be erected, and when completed the old station on Promenade street will be abandoned.

The National Engineering Bureau have opened handsome offices in "The Rookery," Chicago, and are now ready for the transaction of business. The company proposes to take care of special lines of work heretofore divided up among various companies. They will do no construction work, but will furnish expert service to supervise the erection of light and power stations; temporarily operate and maintain plants; furnish experts to test line circuits; prepare specifications with necessary drawings for the information of parties bidding on construction work, etc., and will furnish early information regarding prospective installations. The officers of the company are: George S. Baker, president and legal adviser; James A. Lounsbury, secretary, and Thomas G. Grier, treasurer.

*Some Points in Dynamo and Motor Design.

(*Continued from page* 245.)

12. LOAD DIAGRAMS.

A dynamo having been completed, its performance should be recorded in such a manner that we shall be able to tell at a glance what a machine of similar carcase dimensions will under any circumstances give. First, the machine is run on open circuit, and the relation between the ampère-turns on the magnets and the E.M.F. established. In Fig. 20 the curve, *A B*, shows this, abscissæ giving ampère-turns, and ordinates the E.M.F. While running at the same speed, take the greatest permissible current from the armature, and, keeping this constant, take observations of the magnetizing force and E.M.F., the field being weakened down step by step until it is just possible by adjustment of the brushes to run without sparking. For each reading the brushes will have been adjusted to the sparkless position, and the curve expressing the relation between the magnetizing force and E.M.F., when the maximum current flows, may be plotted as at *Q H*. The curve stops at *H*, because with a further weakening of the field a non-sparking position cannot be obtained. Repeat the experiment for a less current in the armature, then for a smaller still, until there is a series of curves—*Q H*, *E F*, *C D*—as shown, representing the relation between the magnetizing force and the E. M. F. for several different values of the ampère-turns on the armature. It will be observed that as the ampère-turns on the armature get less, the curve can be carried lower, or, in other words, we can weaken the field to a greater extent before arriving at the sparking point.

This load diagram tells us everything we wish to know about the magnetic circuit of a machine having these particular dimensions, and about the interference of the armature on the field circuits. It tells us the ampère-turns required for any induction on open circuit, or, in other words, the magnetizing force required for the shunt only if the machine is to be compounded; it tells us how many ampère-turns must be added to raise the E. M. F. by a required amount with any current flowing, or to compensate any armature load; it tells us how we can over-compound the machine; and, lastly, just how far we can weaken the field for any load without producing sparking. That we can by its aid calculate with accuracy the windings of any machine which requires the same carcase, will be sufficiently obvious without farther explanation.

13. THE BEST RELATION BETWEEN THE IRON AND COPPER IN THE ARMATURE.

It is of some importance to know the best relation between the thickness of the iron core and the depth of the winding which will give in armatures the best results for given dimensions. Suppose we have a cylinder armature of certain radial depth over the winding: while keeping this depth the same, we may vary the iron and copper of which it consists within wide limits. The question is, what relation of copper to iron will give the best results, premising that, however the relation is varied, the temperature shall remain the same. The cooling surface we will take to be unaltered, and this means neglecting hysteresis—for a reason given presently—that the heat generated in the winding shall be constant. Since the waste is constant, the point of maximum efficiency coincides, then, with that of maximum output. If the copper on the outside of the armature is considered as a shell of t thickness, we may, within the limits of our inquiry, take the current that may be carried to generate the same heat $= \sqrt{t}$. The E. M. F. produced will be proportional to the radial depth of the armature core r; and assuming in each case the same degree of saturation, the greatest output for a given radial depth of armature is obtained when $r\sqrt{t}$ is a maximum. This occurs when the exterior layer of copper is about one-fourth the depth of the armature core, the output for different proportions between iron and copper being shown by the curve, Fig. 21. In the diagram the base line *A B* represents half the radial depth of the armature over the winding, distances measured from left to right giving the thickness of the exterior shell of copper. The ordinates represent the output. A dotted line *C D* is erected at the point of maximum. It may be assumed, without any great error, that the weight per unit length of circumference is constant, however the proportions vary, so that the curve may be taken to represent maximum output for a given weight as well as for given dimensions. With a square or bar winding this is about correct.

It will be observed that the relation of copper to iron can be varied considerably without making much difference to the output. An armature, for instance, in which the core is six times the thickness of the copper, gives the same efficiency as one in which the relation is 2.75, and the output is in each case only 3 per cent. below the maximum. The relation for greatest efficiency is quite independent of the degree of saturation to which the core is carried, or the temperature at which the machine is worked.

The effect of hysteresis is to reduce the height of the ordinates, and to displace the point of maximum efficiency to the right. The current which can be taken from the armature is a little greater than $\sqrt{t}$, on account of the heat from hysteresis diminishing as the core is reduced in thickness. But imagining that in all cases the core is saturated to the same degree, the difference in the amount of heat generated from this source is, within the limits of practice, so small a percentage of the whole that its effect on the shape of the curve may be quite neglected.

Machines are not always designed so that the proportions give maximum output, since other considerations arise besides that of the best result from the armature considered by itself. The question of magnetising the core has to receive attention, and the question is resolved into, What is the best proportion for the machine, considered as a whole? The answer to this depends entirely upon the design. In the Phœnix dynamos we work between the limits given by the two vertical dotted lines, *E F* and *G H*, in Fig. 21, finding that there we obtain the best results. If we worked to the right we should get a greater output, we should have a greater air gap, a diminished flux through the armature core, but, on account of the increased stray field, about the same flux in the magnets. The magnetising force and the compensating turns on the magnets would be increased somewhat, while the cross induction would remain about the same. As regards this last point, it is worthy of note that the tendency to sparking, with the usual clearance spaces, remains about the same for considerable variation in the proportion of copper to iron. Increasing the copper does not at all increase the length of the air gap in the same ratio, but in a ratio rather greater than $\sqrt{t}$, or than the current which can be taken from the armature. At the same time the radial depth of the core is diminished, the final result being that $\frac{A_2 w}{r}$ is about constant within the limits of practice.

For drum armatures the relation for maximum output can be similarly determined, and similar conditions fix the limit of departure from the maximum. One point with reference to these considerations should be noticed, and that is, that neither for cylinders nor drums does the point of maximum efficiency or output coincide with the point at which $\frac{\text{watts}}{\text{weight of copper}}$ or $\frac{\text{volts}}{\text{yards of copper}}$ is a maximum, and that these ratios, as applied to compare the performance of dynamos, are accordingly misleading. Given a limiting temperature, the only factors upon which the commercial value of machines should be based are cost and commercial efficiency. Whether the magnets shall be made of wrought or cast iron, whether there shall be a large amount of copper or a small amount, are questions for the manufacturer to decide. In some cases it may pay him to increase the copper and use cast iron, in other cases diminish the copper and use wrought iron. But the finished product is to be judged by its cost to purchase and its cost to run.

14. MOTOR DESIGNING.

These considerations naturally bring us to the subject of motor designing, about which there has been expressed from time to time a good deal of difference in opinion. From the preceding section it will be perceived how far we can go in the direction of getting an increased output from a given weight of armature; and it will have been understood from Section 4 that with somewhat lighter field magnets and a reduced saturation in the armature, a larger yield can be obtained for the total weight, though smaller for the weight of the armature itself. As a general rule, the question of weight does not enter into dynamo designing, except in so far as cost is affected, and a lighter machine means a somewhat increased cost for the output. But in motors it is sometimes necessary to keep the weight as low as possible, and the point to be emphasized here is that in designing light-weight motors we proceed upon lines precisely similar to those adopted in designing light-weight dynamos.

It has been asserted that in motors the armatures ought to be larger compared with the field magnet than in dynamos; and by "larger" must be meant either that the armature cross section is greater, or that the ampère-turns on it are more numerous. As regards the former, it has been shown in Section 4 to what extent the relation between the cross sections of the armature and fields influences the dynamo, and the same reasoning applies to motors; as regards the latter, curiously enough, the examples which I have given in Tables II. and III. show no overloading, but about the same number of ampère-turns is carried as by dynamo armatures—a fact which does not favor the "large armature" school.

My own experiments with series machines, in which the brushes had equal lead and trail when running as dynamo and motor, seem to show that the difference in the E. M. F. generated under these two circumstances is negligible. In Table IV. are given the results.

TABLE IV.—SERIES MACHINES RUN AS GENERATOR AND MOTOR.

Machine.	Revolutions per minute.	V_1.	V_2.	C.	V_1+CR	V_2-CR	Diff.
			GRAMME ARMATURE.				
Phœnix	820	58	136	12.0	98.00	96.00	−2.00
	1,700	134	168	5.0	150.60	151.30	0.70
	1,800	136	168	4.5	151.00	153.00	2.00
			PACINOTTI ARMATURE.				
Phœnix	820	47	80	4.5	63.00	64.00	1.00
	940	58	96	5.0	75.30	78.70	3.40
	1,295	87	130	6.0	107.70	109.30	1.60
	1,430	104	152	6.75	127.30	128.63	1.26
	1,520	106	158	6.75	131.13	132.87	1.74
			BURGIN ARMATURE.				
Bürgin	500	16	116	14.0	64.67	67.40	2.73
	640	36	130	12.5	79.46	86.54	7.08
	720	60	98	4.25	74.11	83.89	9.78
	780	59	138	10.0	93.77	103.23	9.46
	830	66	142	9.0	97.30	110.70	13.40
	840	72	118	4.5	87.00	103.00	16.00
	860	70	144	8.75	100.40	113.60	13.20
	1,100	104	152	4.75	119.77	136.23	16.46
	1,180	114	164	5.0	130.60	147.40	17.20

V_1 = Difference of potentials at terminals as generator.
V_2 = Difference of potentials at terminals as motor.
C = Current, in amperes.
R = Resistance of machine in ohms.

The cores of the Gramme and Pacinotti armatures were constructed of iron washers separated from each other by paper, while the Bürgin armature consisted of a series of hexagonal rings made of iron wire, each forced on to a six-armed gun metal spider. The small differences in the last column may be readily accounted for in the case of the Gramme and Pacinotti armatures by errors of observations, as several things had to be measured simultaneously; but no allowance for errors can account for the difference in the case of the Bürgin machine. I talked over these experiments at the time with Mr. Kapp, who suggested that the difference might be due to parasitic currents arising from imperfect lamination, the forcing of the hexagonal rings on the spiders bringing the wires of the core into actual contact at the corners. When the currents are flowing in the same direction through the machine, the armature rotates, with reference to the field, in the opposite direction of course as generator and motor. Now, apart from the question of parasitic currents, with an irregularly formed armature like the Bürgin—and the Brush with its eight or twelve projections would come in the same category—one is not surprised at a difference in the E. M. F.; the wonder would be if the direction of rotation did not alter the field. But with a Pacinotti ring in which the slots are many and close together, the influence on the field is slight, and with smooth Gramme armatures

* A paper read by W. B. Esson, Member, before the Institution of Electrical Engineers, Feb. 20, 1890.

the field is not affected by the direction of rotation at all, so we get the same E. M. F. produced as generator and motor.

It must be remembered that the effect of the armature current on the field in cylinder machines is by no means small, as will have been observed by the number of compensating turns required to neutralize it. A machine having 13,500 ampère turns on its armature would have about 20,000 on its field magnets, out of which about 4,500 are compensating turns. I mention this to show that the results in Table IV. were not obtained from machines in which the armature effect was negligible, or anything approaching it. The saturation of the core was about 17,000 C. G. S. units.

If a machine is run at the same speed as dynamo and motor, provided the currents in the fields and armature are similar, it will always have a higher efficiency as a motor. If E is the E. M. F. generated by the machine, C the current (imagine it series wound), and R the resistance, the electrical efficiences as dynamo and motor are in the ratio of $\frac{C E - C^2 R}{C E}$ to $\frac{C E}{C E + C^2 R}$, the latter being the greater quantity. If we designate all the other losses save that due to the resistance by p, then for the commercial efficiency we have $\frac{C E - C^2 R}{C E + p}$, and $\frac{C E - p}{C E + C^2 R}$. If p had the same value as $C^2 R$, the efficiency of dynamo and motor would be similar; but since p has always a lower value than $C^2 R$, the motor has still the advantage.

15. CONSTANT POTENTIAL MOTORS.

Now, as regards another thing which we have been told sometimes—that the armature and magnet fields are added in a motor—so far is this from being the case, that, under the usual and proper conditions of a trial on the brushes, the weakening of the field due to the current in the armature may play a most important part in the governing of motors at constant speed. In an article contributed to the *Electrician* in 1886, I hinted at this, saying, "By reason of the current in the armature reacting to weaken the field, does not a shunt motor contain within itself the germ of self-regulation, which, by suitable proportion, may be made effective without a series coil at all?" Since that date motors have been constructed in which the truth so foreshadowed has been realized.

As already stated, the E. M. F. of a separately excited dynamo is represented by an inclined line, $C D$. Fig. 15, the inclination showing the weakening of the field produced by the current in the armature. Run as a motor, with a trail equal to its lead as a dynamo, the E. M. F. generated—called in this case the back E. M. F.—will be the same, being greater, therefore, as the current is smaller, and smaller as the current is larger. A shunt motor connected to mains at a constant difference of potentials has its magnets excited by a constant current, and the back E. M. F. varies in this way. Its value, calling E_1 the difference of potentials at the mains, is $E_1 - C R$, and it is, of course, proportional to the induction through the armature and the speed. Generally we require the latter to be constant, so we write.

$$n \propto \frac{E_1 - C R}{N_1},$$

where N_1 is the resultant induction through the armature due to both fields. As we have seen, N_1 is not a constant: there is a weakening of the field proportional to the current; and for N_1 we can substitute a value, $N - f(C)$, where N is the induction on open circuit, and $f(C)$, that function of the current which represents the weakening effect. Writing

$$n \propto \frac{E_1 - C R}{N - f(C)},$$

it is perfectly obvious that if $C R$ bears the same relation to E_1 as $f(C)$ bears to N, the speed, n, will be constant, and quite independent of the load. Referring to Fig. 15, the height, $O C$, may be taken as representing the induction when the motor is running with no load; the sloping line, $C D$, giving the induction for various currents in the armature. The horizontal line, $C E$, will represent the induction due to the field magnets alone, and the difference of potential at the mains. If the speed be constant the length of ordinates between $C D$ and $C E$ represents $f(C)$, and also $C R$. We see clearly that if the induction is diminished without a proportional reduction of the back E. M. F. the speed will increase; while, on the other hand, if the back E. M. F. goes down without a corresponding decrease in the induction, the speed will be reduced. If it is found that the speed increases as the motor is loaded—and I have seen this—the field must be strengthened, and the turns of the armature reduced, or the armature resistance increased. If the speed gets less, an opposite course must be taken. A shunt motor, then, will run at a constant speed on a constant-potential circuit without compound winding or any other device, if the armature field and magnet field are properly proportioned. A position can generally be found for the brushes where the sparking between the load limits is inappreciable, and the motor may be then trusted with perfect confidence to run at a constant speed.

It must not be thought that because a motor transmits power, it is necessary to manipulate electro-mechanical equivalents until we get torque in pound-feet or foot pounds per revolution, or some other mechanical quantities. This is only a waste of time. In designing a motor we know the horse-power or watts to be given off on the brake at a certain speed, and if we make the machine run at the proper number of revolutions, and in accordance with the conditions of electrical supply, the torque will come out all right without our troubling about it. Suppose we require W watts to be given out on the brake by a motor working on a constant-potential circuit. The power which must be converted in the armature is greater by a certain amount, p, absorbed in friction of journals and brushes, magnetic friction, and parasitic currents. This amount can be foretold to a certain extent, but may be derived from experiments made with machines of the same kind. The power converted being, then, $W + p$ watts; the back E. M. F. being settled as determined by the waste allowable in the armature, the current $= \frac{W + p}{E}$ is obtained; the procedure in design now being exactly as for a dynamo to give a current of $\frac{W + p}{E}$ ampères by E volts at the same speed. If these conditions are fulfilled, the torque may be left to itself.

16. CONSTANT CURRENT DYNAMOS.

There seems to be an impression that dynamos for high differences of potentials cannot be worked successfully with Gramme commutators, the reason for this opinion being, I suppose, the break down of some imperfectly constructed machines. That there is no difficulty with the insulation between the conductors and armature core is obvious from the fact that high-potential alternating-current machines are working successfully with armature sections similarly disposed. The fault appears, therefore, to have been solely with the commutators. I need only reiterate the remark I made here a short time ago, that there is no difficulty whatever in constructing Gramme machines up to 1,000, 1,500 or even 2,000 volts, provided the designer knows what he is about. Many such machines are to be seen in daily work. Mr. Bogue, of New York, gives me particulars of a Wood dynamo manufactured by his company which gives 9.6 ampères, and a difference of potential of 2,640 volts at

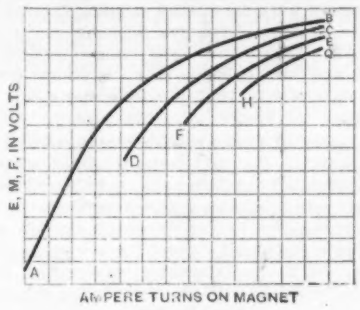


FIG. 120.

its terminals; Mr. Henrion, of Nancy, constructs Schuckert machines of 1,000 volts: Messrs. Immisch & Co. have constructed motors as well as dynamos of 1,000 volts; while Messrs. Paterson & Cooper have a large number of machines running at voltages varying from 800 to 1,500. The latter run without sparking at the brushes, and with perfectly smooth commutators.

Several attempts have been made to compound machines for constant current, all of them uniformly unsuccessful. It is beginning to be realized that, Deprez notwithstanding, it cannot be accomplished, and during the next six years the equations for constant-current compound winding may finally disappear from our text-books. But it may take longer.

The method of regulation about which I have to make a few remarks, is that of rotating the brushes on the commutator, which has proved very successful in some of the machines to which it has been applied. You need scarcely be reminded that if a series-wound machine is directly belted to a separate engine the combination is almost self-regulating, such small correction as is required being easily effected by a solenoidal electrical governor. In such cases the speeds of both engine and dynamo vary as the E. M. F., but generally this arrangement is not permissible, in consequence of several machines being driven from the same countershaft; accordingly, some device for regulating at constant speed has to be adopted.

In machines in which the current is variable we endeavor, as I have said, to make the self-induction as small as possible, and we work with the brushes somewhere between the polar tips where the field is almost neutral, or only of strength sufficient to overcome the slight effect of self-induction, and bring the current up to its normal value before the section leaves the brush. In constant-current machines we work always in the active field under the pole-pieces, and to prevent the flow of an enormous current in the section short-circuited by the brush, considerable self-induction has to be given. Consider an armature in the field, Fig. 16. Opposite the parts marked N and S the induction through a section is *nil*; at A and B it is 16,000, 17,000, or 18,000 C. G. S., as the case may be—that is in the machines we have been speaking of hitherto. If

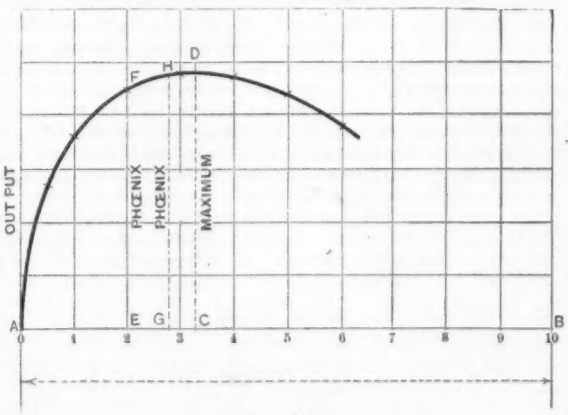


FIG. 121.

we had here a uniform distribution of field over the poles, an attempt at constant-current regulation by movement of the brushes would only result in sparking, since in every position the back E. M. F. of self-induction is different. If the induced E. M. F were in one position, balanced by the E. M. F. of self-induction, in other positions it would be over-balanced or under-balanced. Another point is, that if regulation is attempted by working with the brushes partly between the polar tips and partly under the poles, the weakening effect of the armature current on the fields is subject to great variation; accordingly, the poles should be extended until the brushes are under them in every position. The essentials for successful regulation will now be apparent. First, the self-induction should balance the field in every position of the brushes; secondly, the poles should be extended so that the brushes in every position of working are under them. An examination of the curve, Fig. 1, will show that up to an induction of 12,000 or so, the co-efficient of self-induction is, roughly, constant; so that an armature core saturated to this degree would have the same E. M. F. of self-induction for a constant current whatever the position of the brushes. In the Wood dynamo already referred to, the induction in the armature is 13,000 per square centimetre, and in the Sperry dynamo, which hails from Chicago, it is about 14,000.

In both these machines the masses of iron in the magnets and pole pieces are disposed so that the field is fairly uniform over the poles; but this is by no means necessary, provided the E. M. F. of self-induction balances the field in every position. Making the field distribution uniform, and the self-induction uniform, affords the easiest method, however, of attaining the end in view. It remains only to say that the field at the short-circuited section is greatly reduced in strength by the current in the armature, and that the best number of turns per section must be determined by experiment. It will be evident that the single magnet type of machine, as illustrated in Fig. 7, is the least suitable for constant current; and, while in America they choose the best form of magnet for the purpose right away, in this country the attempts at regulation have been made very often by selecting the worst form and chopping away at the poles until it comes about right.

It is unnecessary to describe the various forms of apparatus for shifting the brushes. Briefly, they consist of a mechanical device, electrically controlled, whereby the brushes are moved forwards or backwards on the commutator as the current rises or falls slightly. Upon the rapidity with which this regulator responds to variations in the current depends the successful working of the machine. If the current is allowed to rise or fall outside a small percentage, the adjustment of the fields is thrown out of balance, and sparking results. The importance of having a regulator which is sensitive, and acts with promptitude, will therefore be apparent.

17. RELATION OF SIZE TO OUTPUT.

Great differences of opinion exist about the relation of size to output in dynamos. Prof. Thompson in his "Dynamo Electric Machinery," quotes several writers who give the output at figures varying from the square to the fourth power of the linear dimensions, and the subject has been discussed to some extent in this room. Mr. Kapp has worked out the relation, and, assuming that in larger machines the space taken up by the insulation is proportionally less, more copper being accordingly got on the armature, he makes the output for a machine whose linear dimensions are increased n times from n^3 to $n^{3.5}$ the speed being inversely as the linear dimensions. Prof. Ayrton thinks it ought to be higher than $n^{3.5}$, while Dr. Hopkinson finds that, everything considered, it comes out about n^3. With the single exception of Dr. Hopkinson, I am not aware that any one has mentioned the consideration which, above all, determines this relation—that is, the interfence of the magnet and armature fields.

If the armature of a machine is lengthened, the electrical work which can be performed by it is increased in proportion. The magnetizing force and the ampère-turns on the armature remain the same, and the forward and cross induction bear to each other the same ratio. Here the electrical work for the same number of revolutions per minute is proportional to the weight of the magnetic system, and rather more than proportional to the total weight. The surface velocity of the armature is, of course, unchanged. Let all the linear dimensions of the magnetic system be increased n times. The length of each component of the magnetic circuit being n times longer, the magnetizing force must be n times greater for the same degree of saturation, the total forward induction having n^2 times its former value. The copper on the armature being n times thicker, the ampère-turns which may be carried to raise it to the same temperature will be $n^{\frac{3}{2}}$, and the output, therefore, at the same number of revolutions per minute, $n^{3\frac{1}{2}}$, the E.M.F. being n^2. If the speed is inversely as the linear dimensions, the output is obviously $n^{2\frac{1}{2}}$. Now, in increasing all the linear dimensions—the air gap in proportion—we have increased the tendency to sparking. The lengths of the cross circuits are n times longer; consequently, for n times the ampère-turns on this armature, the ratio of the cross induction to the forward induction would be as formerly. But we have put on it $n^{\frac{3}{2}}$ ampère-turns, and the air gap must be therefore increased in the same proportion, in order that the tendency to sparking may be neutralized. Under these circumstances the magnetizing force will be greater than n; but, taking into account the increased air gap, and the increased compensating ampère-turns on the magnets, the weight of the copper on these will not be greater than n^2; and this amount we can afford to have on a machine in which the other weights are increased in similar ratio. It appears then, that, with due regard to the balance of the magnet and armature fields, the output is not quite proportional to the weight, if the surface velocity of the armature remains the same, but that for similar machines it increases as the $2\frac{1}{2}$ power of the linear dimensions. Of course this depends to a great extent upon the original machine. If the armature of this is under-loaded, it may be quite possible in the larger machine to take advantage of the condition that less space is taken by the insulation, and so load it to a greater number of ampère-turns than $n^{\frac{3}{2}}$; but if the balance of fields is to be the same in each, $n^{\frac{3}{2}}$ represents the permissible ratio of ampère-turns. It will be found, I think, that where the output increases directly as the weight, the surface velocity of the armature is in the larger machines greater.

With these remarks I bring this somewhat lengthy contribution to a conclusion.

Board of Electrical Control.

The present experience of the representatives of the Standard Construction Company seems to confirm the truth of the old adage which treats of the perils attendant on the apparently easy transition from the cup to the lip. For some weeks it has looked as if nothing could further intervene to prevent the signing of the contract with the new subway company, but as each succeeding day for the meeting of the Board of Electrical Control arrived, some obstacle has presented itself, and this bustling corporation, which has so many friends in high places, seems virtually as far removed from the consummation it so devoutly wishes as it was a month ago.

The difficulty in the way at the last meeting of the Board on the 31st ult., was indicated by a statement of Assistant Corporation Counsel Dean, that under the recent decision of the General Term of the Supreme Court, the proposed contract with the Standard Company could not be entered into by the Board at present. He said also that the only way in which the Board could overcome the difficulty would be by drawing up a new contract. This step, however, was opposed by Wheeler H. Peckham, who was of opinion that it would simply result in another injunction. He was sanguine of a final decision of the General Term in three or four days, and advised that the matter be laid over until then.

The Commissioner of Public Works stated to the Board the result of his conference with the representatives of the electric lighting companies, which was, that in every street that he had arranged to pave he found subways were going to be laid, and he again repeated, and laid stress on his recently expressed determination to allow of no laying of subways in any street after it was repaved.

Mr. Lauterbach suggested that the Edison company be allowed to go on with the laying of subways until matters assumed a more definite aspect, but P. D. Cravath and W. H. Kelly, on behalf of the United States and East River companies, protested against this, as being unfair to the other companies. Permission was given to the Empire and Bay State Telegraph Company, who were represented by ex-Commissioner Daniel L. Gibbens, to erect a line of poles and wires from Yonkers to Harlem Bridge.

No further business of importance was done, and the Mayor stated that at the next meeting the order for the building of the subways would be given absolutely, whether it was to be done by the Consolidated or by the Standard Company.

The meeting adjourned to the 3d inst. On the 3d inst. there was a further adjournment to the 5th. On the 5th inst. there was still another adjournment to the 7th.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York. April 7, 1890.

Norman Hubbard, of Brooklyn, L. I., is making a full line of improved steam pumps for electric light stations. A full description will be furnished upon application.

The Pulsion Telephone Company, of New York, lately put in a telephone for the Walker Electric Company, 50 Broadway, and the company are entirely satisfied with it.

Bates, McIlhargy & Co., 47 Dey street, are pushing the Korting gas engine, for steady running power use, and will furnish estimates for running dynamos and other machines.

The Last Installment of the 2,250-light plant for the Municipal Company of St. Louis will be delivered on April 9 by the Fort Wayne Electric Company, which has the contract. They are arc light dynamos, made by J. J. Wood, Brooklyn, N. Y.

John S. Hall, 40 Cortlandt street, is placing quite a few of his special waste oil filters among electric light and power users. He is handling also the economy brush holder for dynamos. He has added some valuable improvements to his dynamo oil cups.

Mr. C. S. Knight, of the Fort Wayne Electric Company, Fort Wayne, Ind., was in town this week, and speaks in glowing terms of big orders which this company have for alternating apparatus. Mr. Knight is giving a great deal of attention to the development of large gas engine plants.

The Crosby Electric Company, Judge Building, are presenting some valuable specialties, among which is their Crosby Dry Battery, which they state will give 1.55 volts and from 1 to 10 ampères, according to size, of which they have several. Their circular gives a minute description of this battery.

Mr. W. H. McGrath, so well known here as the former superintendent for the Brush Electric Illuminating and Manhattan companies, is now hard at work reorganizing the business in New Orleans, and installing five 2,000 and two 1,000-light alternating dynamos, the first installment of the 20,000-light plant they are to have here.

Niagara Steam Pump Works.—Mr. Allen, the manager of this large Brooklyn concern, is taxed very heavily nowadays with overwork, and the men work day and night in order to satisfy the demand for this popular pump. Withal, Mr. Allen still finds a moment to spare to entertain his friends at his office, 118-122 Plymouth street.

T. McCoubrey, of the Crocker-Wheeler Motor Company, was in an exuberant frame of mind one day this week, in consequence of the great success of their motors. They have shipped 1-6 and ⅓ h. p. motors to the extent of nearly $2,000, to Shippy Brothers, London, their agents, in the past week. These include Gould cylinder pumps and fan outfits.

Mr. J. Goldmark, representing Wallace & Sons, 89 Chambers street, the noted manufacturers of copper wire, rod, sheet, tubes, etc., and the Little Joker Dynamo, returned lately from an extended trip to New Orleans. He met with an excellent reception throughout his trip, and has many mementoes in orders for his house. Since his return he has secured some nice orders in copper wire, one of which was for nearly 26,000 pounds.

The Magnolia Anti-Friction Metal Company has just issued an interesting sheet of photographs showing tests of their metal and other material used for the same purpose. Both the photographs and the conditions under which the tests were made were of a very striking character, the velocity of the rubbing surface during the tests being extremely high, and the pressure unusually great.

The Bishop Gutta Percha Company, finding their capacity inadequate to the largely increased demand for their specialties, lately added to every department a new and improved line of machines for the manufacture of their goods. Mr. W. G. Armstrong has placed some big orders for their specialties, and has been so busy here that he has been unable to call upon his customers out of town.

Mr. Henry Hine, of the Westinghouse Electric Company, 120 Broadway, has lately contracted with the Bluff Point Hotel, Plattsburg, on Lake Champlain, for a 1,500 16 c. p. light Westinghouse alternating plant. The dynamo and engine room is at the lake side, one-half mile from the hotel, and connected with the hotel by a standard underground cable. There are two dynamos, two Westinghouse 75 h. p. engines and Worthington pumps.

The Goulds Manufacturing Company, 60 Barclay street, are exhibiting their triple cylinder electric pump set on the same base with a Crocker-Wheeler motor in full operation. The motor circuit is so arranged that when the tank becomes full of water it cuts out automatically. These outfits are meeting with a ready sale. The motor runs the pump by the Evans friction system, the small pulley of the motor working directly on the large pulley of the pump.

The Subway Contract.—The order of the General Term of the Supreme Court, upon its decision rendered a week ago holding that the Board of Electrical Control cannot carry out its proposed contract with the Standard Electrical Subway Company, because of fatal defects in it, was settled last week. The order enjoins the Board of Control from carrying out the contract proposed until the changes suggested by the decision of the Court are made, and the defects referred to remedied.

Bateman & Pollard, 143½ E. Twenty-third street, are wireing up Eugene Jones' mansion at Tarrytown, including stables, for 125 16 c. p. lamps; current furnished from Tarrytown station, Thomson-Houston dynamos, Habirshaw best white core wires and cables. There will be some fine combination fixtures of the Mitchell and Vance Co. and Bergman & Co. make; one switch controls all lamps in the house; each room is controlled by individual switch; the stable is on a separate circuit.

New York Electrical Manufacturing Company are making every preparation for a large business, preparing for a large power plant in a Western mine, and are figuring on plants in New York City. Three motors are to be installed for ventilating, in New York City; 10 h. p. motors for Brooklyn elevators, and is figuring on several large electric light plants for this city. They have issued a new circular, very prettily and compactly arranged, which gives very useful information of their goods and prices.

Mr. A. H. Patterson, General Manager of the Phœnix Glass Company, 729 Broadway, has added many new lines of incandescent and arc light globes and shades to his already large exhibition. His Phœnix crystal arc light globes are worthy of attention; they are made of a special quality of glass, carefully annealed after being formed by hand. They are made in any style required, and for all systems. Efforts have been made to perfect the most tasteful designs, and floral patterns in finely etched glass incandesant shades in such variety that the most fastidious taste may find gratification.

A. L. Bogart, 22 Union square, was found in a most sanguine mood. He is fitting out the Pedie Memorial Church, of Newark, with a complete outfit of electric gas lighting. The 900 gas jets will be simultaneously lighted by induced currents of electricity generated by Mr. Bogart's patent frictional electric gas lighting apparatus. Pedie Memorial Church is a very imposing edifice in brown stone. St. Joseph's Cathedral, of Hartford, Conn., excels the St. Patrick's Cathedral of New York. The interior is decorated with representations of the New Testament characters, and is of the most elaborate description. The memorial windows are works of art by the most famous of artists. The nearly 1,400 gas jets will be lighted by Bogart's electric gas lighting system.

National Electric Protector Company, 18 Broadway, speak in highly satisfactory terms of the demand for their instruments, a most encouraging order for 50 of which was lately received from the Providence, R. I., Fire Department, who have been using a large number for the past four years. This last order shows that they are giving satisfaction. Numerous smaller orders are being filled daily. The principal fire departments throughout the large cities of the Union are adopting them. The Brooklyn City Fire Department also have them in use. The instrument automatically protects from "burn outs" and accidents occasioned by lightning and the crossing of wires. It is designed for fire-alarm boxes, telegraph and telephone instruments, etc., and each machine is tested before it is sent out.

Wellington's automatic furnaces for electricians' use have many advantages. The automatic valve air pumps to force air into the reservoir creates a steady, stiff pressure, thus producing a blast of intense heat so necessary for soldering joints in wire. It does away with danger arising from deflecting heat from the burner to the reservoir, to vaporize and expand the oil to keep up the pressure; it consumes naphtha of 72 to 76 degrees specific gravity, or gasoline. They are made of brass and galvanized iron, avoiding weakening or corroding or rusting. Many are in use on our subways not only for soldering but for melting the compounds used on the joints of wires and cables, particularly by the Complete Electric Construction Company, who are laying many of the wires and cables in the conduits.

C. R. Vincent & Co., 15 Cortlandt street, contractors for electric and power plants, and agents for the Ball engines, have recently placed the following engines: Albany *Journal*, Albany, N. Y., 30 h. p.; Meriden Electric Light Company, Meriden, Conn., 155 h. p.; Aluminum Brass and Bronze Company, Bridgeport, Conn., 80 h. p.; Sprague Electric Railway Company, Winston, N. C., two of 135 h. p. each; Wechsler & Abrahams, Brooklyn, N. Y., Continental dynamos, 800 incandescent lights, 25 arcs, two of 150 h. p. each and one of 50 h. p.; Jas. A. Hearn & Son, New York, one 60 h. p.; Cincinnati Edison Company, Cincinnati, O., 150-h. p.; Fall River Line steamer "Plymouth," two 65 h. p. compound engines; U. S. gunboats "Concord" and "Bennington," two compound engines on each; monitor "Miantonomoh," two double engines; Okonite Company, Passaic, N. J., one 30 h. p.

R. J. Steen, 45 Broadway, of the Cobb Valcanite and Wire Company, showed some fine specimens of their improved insulated wires. The insulating compound is vulcanized in a special manner, and is so applied as to leave no joints, and perfectly flexible under all conditions. He twisted and bent sections of No. 6 stranded copper wire was covered with the insulation without any effect upon its continuity. The insulation is hard and tough, and for a special guard a layer of cotton cord is twisted and, in connection with melted paraffine, is laid between the insulating compound and an outside covering of lead. This combination is particularly adapted for all underground work. They make wires to carry currents and voltage of any capacity required. They have over forty miles of wires in the conduits of New York, successfully carrying the highest voltage. He showed a letter from one of the largest companies in this city, speaking in the highest terms of these wires. These conductors are guaranteed perfectly water, acid and moisture proof. One great feature of their system of putting wires in the conduits is a special joint (patented), and trebly insulating the wires before covering it with a lead casing of a compact and simple form. In addition to the Cobb system of wires and cables is a new Cobb underground conduit system which has been tested successfully. Another of the company's specialties which will come into universal use, is a new aerial insulated wire; this will be used for wiring buildings, etc

Mr. S. M. Hamil, Secretary of the Brush Electric Company, and General Manager of New England States branch of the business, offices 36 Union Square, is meeting with unusual success in the introduction of the practically new and improved Brush alternating system. Among a few of the latest contracts for plants now under construction is a 1,000-light plant for Woonsocket, R. I., run by one of the improved 100 h. p. Otto gas engines; 1,000-light alternating and two 30 arc light dynamos for Auburn, Me., run by water power; 600-light alternating for Bristol, Me., water power; 600 lights for Dexter, Me., run by Hercules water motor; 1,000-light alternating and 100 arcs with Ball engines, at Haverhill, Mass.; 600 lights, Camden, Me., run by Holmes' water-wheel. Superintendent C. W. Phipps is now constructing the plant in the cruiser "Miantanomoh" at the Brooklyn Navy-yard, and will install 250 lights of the Brush direct current system; there will be one dynamo of 3,200 watts and two of 1,600 watts, and two new Ball vertical compound double cylinder engines. The plans for the wiring of this cruiser are an enterprising piece of work, and the Navy Department call for the best Habirshaw wires. Mr. Hamil says that Mr. P. R. Prentis has been secured by his company and is actively engaged in the supervision of some of the largest installations. M. E. L. Bradley, a well-known electrician, has been employed by this company for some time, and lately returned from an extended trip through the South and West in the interest of the home office.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 8, Cook Building, cor. Franklin and Congress Sts.
Boston, April 5, 1890.

A survey is being made for an electric railway between Dover and Great Falls.

Kendall & Slade are having large sales of their improved adjusting blocks.

Wallace & Sons, Ansonia, Conn., have recently introduced the welding of wire by electricity.

Robinson Radial.—The new electric open car at the Newburyport car works has been completed.

Fire Alarm.—The selectmen of Medford contemplate the erection of a fire alarm system in that town.

Spencer, Mass.—Two new 500-light dynamos have recently been put into the shoe factory of Isaac Prouty & Co.

Peabody, Mass.—The town has voted to accept the majority report on electric lighting in favor of a town plant.

Canton.—There was an exhibition of the Stevens fire alarm system in this town last Tuesday and Wednesday evenings.

The Gethins Electrical Company have received a large order from the Mexican Central Railway Company for their improved battery.

The American Magneto Clock Company have just installed all the buildings of the Institute of Technology with their system, 39 stations in all.

Greenfield, Mass.—The citizens of Greenfield have voted to instruct the selectmen to make a contract with the electric light company to light the streets for five years.

Hingham.—The town committee on electric lighting held a meeting at the office of the Hingham Water Company last Wednesday evening. Progress was reported—adjourned.

N. E. Electric Company, agents for the Sprague Electric Railway and Motor Company, will remove about April 15 from their office on Oliver street to new and spacious offices at 12 Post office square.

The Wainwright Manufacturing Company, of Mass., have just shipped seven of their improved corrugated copper tube condensers, of 200 horse-power each, to the Carolina Oil and Creosote Company, Wilmington, N. C.

Holyoke and Chicopee.—An electric railway is expected between the above two points when the Willimansett bridge is built. The local street railway company is already making overtures towards securing the right of way over the coming structure.

North Adams, Mass.—The electric road at North Adams is giving great satisfaction, and the people of that section are just beginning to appreciate the value of electricity as a motive power in traveling. The road has run smoothly all the winter, and is well patronized.

Cambridge.—The committee on police has received proposals from three firms for putting in the police signal system. There will be thirty boxes in all, two being located in each of the First, Third and Fifth wards, and twenty-four in the Second and Fourth wards, which comprise the Second Police district.

South Framingham.—The Framingham Street Railway Company was organized in this town last Thursday night. This corporation proposes to construct and operate a street railway in the town of Framingham, from the Natick and Sherborn line, and the motive power is to be either electricity or horse or both, as occasion may require.

The Suburban Light and Power Company gave an exhibition of the Westinghouse system of arc and incandescent lighting at their station on Norfolk avenue, Roxbury, on Thursday of last week. This company are furnishing a large number of lights in the neighborhood, the work being done by the North American Construction Company.

West End Railway.—Changes were made on the running time on all the electric lines of this company last Thursday, in order to conform to the recent aldermanic vote reducing the speed of street cars. A new line of motor cars was started last week between Harvard and Bowdoin squares. By this line forty trips a day are added to the former accommodations.

Windsor Locks, Conn.—The local electric light company will soon begin work on the completion of their new plant. The materials are expected in about two weeks. The company has bought the lower No. 2 Stockinet, which has been idle for a long period. The dynamos will be two in number, 500 lights capacity each, and will be run by water. Steam power will also be added. Nearly all the mill owners have signified their intention of using the light in their mill rooms.

Society of Electricians.—Fifty-four electricians met in the *Herald* Building Tuesday evening, the 25th, and formed a society to be known as the Massachusetts Electrical Engineers and Mechanics' Association. The following officers were chosen: President, John Dean, Jr.; vice-president, James E. Monroe; secretary, R. Vose; financial secretary, C. H. Tyler; treasurer, Andrew Hanson; conductor, W. C. Woodward. Their principal object is mutual benefit in exchange of ideas, etc.

Lassoed by the Trolley.—A peculiar accident happened to Eugene Sullivan, conductor on a Blue Hill avenue car, last Thursday evening. The rope which controls the trolley pole got caught in a span wire, and in some way entangled itself about Sullivan's neck. In an instant he was jerked over the dasher and hurled to the pavement. He was picked up and carried into a neighboring drug store, where it was found that his head and hands were cut and his hips thrown out of joint. After being cared for Sullivan proceeded to his home in Dorchester.

Concord, N. H.—Preparations for equipping the Concord Horse Railroad with electricity as a motive power are well advanced. Contracts with the Thomson-Houston Company were signed several weeks ago. A 115 h. p. engine and boiler to correspond have been ordered of the Swampscott Machine Company, to be delivered in six weeks. The wire was ordered a fortnight ago, and the location of the poles has been determined. Work will be pushed as soon as the city council appoints its electrical supervisor under the recent ordinances. Two of the new cars have been painted, and a third is ready for the roof.

After six months' waiting the people of Attleboro, Mass., have seen the first electric car run on the new road. The long-talked-of electric street cars which were to be run last fall by the Attleboro, North Attleboro & Wrentham Co. have at last been put in running order. The first car over the tracks of that company operated by the power of electricity was run over the road at 2 o'clock Sunday afternoon. Had it not been the Sabbath it would have been a gala day for Attleboro. The operation of the car was smoother than could be expected. The road opens up a large territory of excellent land which heretofore has been of no great value.

Gardner, Mass., is having a brisk competition in the electric street railway business. Four weeks ago the same parties who are

securing the franchise at Athol and Orange published their only corporation notice for Gardner. They proposed to construct 3¼ miles of road connecting the three villages of the town and using the double trolley system. Now comes the Gardner & Templeton Electric Street Railway Company, which proposes not only to connect the villages, but to extend the road to East Templeton, laying six miles of track. This concern is backed by W. A. Bowland, of Lynn, who takes 200 shares; W. B. Ferguson, of Malden, 249 shares; E. P. Shaw, of Newburyport, 50 shares; J. H. Cunningham, of Chelsea, 50 shares, and C. C. G. Thornton, of Cambridge, 25 shares, the remaining 26 shares being subscribed for by Gardner men. This company proposes to use the single trolley system, and will make a vigorous effort to get the franchise.

The Denio Automatic Fire Detector, is the name of an ingenious device for transmitting an alarm signal to any desired point by the melting of a seal, fusible at a definite temperature higher than normal and changing the connections of an electric circuit. It may be described as a combination of an ordinary push button with a small cup inserted in a larger one, firmly soldered together within, and a spiral spring inserted into and held by both, the alloy melting at 150 to 160 degrees Fahrenheit, and releasing the cup which is forced out of the thimble by the expansion of the spring, the electrodes brought into contact and the alarm conveyed to a central station. The device is cheap and simple, is applicable to open or closed circuits, and to all purposes where the use of a detector is required, and is designed to replace complicated and expensive instruments. In addition to its capability for use in new plants, where any desired arrangement of wiring may be adopted, it is adapted for use in existing systems without alterations, as in hotels and steamers where an annunciator is already in use. This little appliance is being introduced by the Denio Automatic Alarm Push Button Co., Hathaway Building, 620 Atlantic avenue, Boston.

The latest improvement in arc lighting is the Russell electric arc lamp, for which letters patent were granted last year. It is claimed that this lamp embodies features that will finally drive the double pencil arc light out of the market. The new lamp is distinguished from other arc lamps by the use of a carbon disc in place of the upper pencil. The vibration of the armature causes the disc to slowly revolve, and thus burn evenly around the centre. There is, therefore, not so much space needed for the long upper pencil, which, being the pole of the positive current, burns twice as fast as the lower pencil, and must, therefore, be so much larger. The disc presents a greater surface of contact, consequently a much stronger and steadier light. The Russell lamp will burn 12 or 24 hours, according to the style and size used. The cost is the same, and therefore there is on the side of the Russell lamp economy both in light and material, as well as in the cost of attendance. The eight-hour Brush lamp is 52 inches in length, and the 12-hour Russell lamp but 30 inches. The new lamp for the 24-hour size is 50 inches in length. An inspection of the Russell lamp at the office of the company, 85 Water street, shows unmistakably the advantages mentioned above.

Sales of the Wainwright Improved Heaters and Condensers during January and February, 1890, with 10 years' guarantee: Seven 200 h. p., Carolina Oil & Creosote Co., Wilmington, Del.; one 8 h. p., H. M. Sciple & Co., Philadelphia, Pa.; one 15 h. p., H. S. Walker, Chicago, Ill.; one 50 h. p., Buckeye Eng. Co., Salem, O.; one 500 h. p., M. Kress Brewing Co., New York, N. Y.; one 200 h. p. Randolph & Clowes, Waterbury, Conn.; one 80 h. p., I. E. Palmer, Middleton, Conn.; one 50 h. p., Bailey & Sons, Winthrop, Me.; one 80 h. p., H. M. Sciple & Co., Philadelphia, Pa.; one 30 h. p., H. S. Walker, Chicago, Ill.; one 75 h. p, Ireland & Mathews, Chicago, Ill.; one 150 h. p., Knowles Loom Co., Worcester, Mass.; one 60 h. p., H. S Walker, Chicago. Ill.; one 300 h. p., Seymour Mfg. Co., Seymour, Conn.; one 100 h. p., H. S. Walker, Chicago, Ill.; one 50 h. p , St. Louis Machine Co., St. Louis, Mo.; one 25 h. p. H. S Walker, Chicago, Ill ; one 150 h. p., N. E. Shoe & Leather Exchange, Boston, Mass.; one 25 h. p., J. S. & G. F. Simson, Brooklyn, N. Y.; one 25 h. p., H. S Walker, Chicago, Ill.; one 150 h. p., G W. Carley, Supt., Georgetown, D. C.; one 40 h. p., Davis Shoe Co., Lyman, Mass ; one 75 h. p., Bell Armstead Mfg. Co., Vincennes, Ind.; one 30 h. p., P. S. Walker, Chicago, Ill.; one 60 h. p., New Brighton Glass Co., New Brighton, Pa.; one 100 h. p., Osborne & Kelly Mfg. Co., Hamilton, Ont.; one 50 h. p., H. S. Walker, Chicago, Ill.; one 150 h. p., Uxbridge & Co., Uxbridge Elect. Co., Uxbridge, Mass.; one 150 h. p., Jno. Post, to L. C. Bass Mfg. Co., Guilford, Me.; one 50 h. p., A. Coburn & Sons, Hopkinton, Mass.; one 100 h. p., Copeland & Bacon, New York, N. Y.; one 50 h p., Russell, Boynton & Co., Minneapolis, Minn.; one 50 h. p., Perrin & Seamans, Boston, Mass.; one 25 h. p., James Rees, Pittsburgh, Pa.; three 100 h. p., New York Safety Power Co., New York, N. Y.; one 75 h. p., H. S. Walker, Chicago, Ill ; one 100 h p., P. & F. Corbin, New Britain, Conn.; one 400 h. p., Haynes Palace Car Co., Buffalo, N. Y.; one 400 h. p., Gorham Mfg. Co., Providence, R. I.; two 15 h. p., C. F. Smith, Pittsburgh, Pa.; one 75 h. p., H. S. Walker, Chicago, Ill.; one 100 h. p., Chicago Steam Heating Co., Chicago, Ill.; one 60 h. p., H. S. Walker, Chicago, Ill.; one 25 h. p., Ætna Power Co., Millers, Ind.; one 30 h. p., E. O. Knight, Worcester, Mass.; one 60 h. p., H. S. Walker, Chicago, Ill.; one 100 h. p., Southern Pavement Co., Ft. Payne, Ala.; one 300 h. p., Rutland Electric Light Co., Rutland, Vt.; one 100 h. p., Diamond Ice Co., Roanoke, Va.; one 300 h. p., Frazier & Co., New York, N. Y.; one 300 h. p., H. S. Walker, Chicago, Ill.; one 100 h. p., H. Disston & Sons, Chicago, Ill.; one 75 h. p., J. E. Hubbard, Greenfield, Mass.; one 30 h. p., H. S. Walker, Chicago, Ill.; one 125 h. p., H. S. Walker, Chicago, Ill.; one 100 h. p., W. H. Cook, Chicago, Ill.; one 80 h. p., Buckeye Engine Co., Salem, O.; one 60 h. p., Buckeye Engine Co., Salem, O.; one 25 h. p., H. W. Petrie, Brantford, Canada; one 300 h. p., Detroit Electric Light Co., Detroit, Mich.

L. H. H.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY TRUST BUILDING. PHILADELPHIA, April 5, 1890.

Hughes & Gawthorpe, of Pittsburgh, have closed contracts with the Pittsburgh Plate Glass Company for the installation of a 900-light incandescent plant in their factory at Tarentum, and a 3,000-light plant in their works at Creighton, Pa., both of the Thomson Houston system.

Among the successful Philadelphians at the Patent Office during the past week were the following: Ludwig Gutman, for choking electro-magnets; Rudolph M. Hunter, assignor to Thomson-Houston Electric Company, of Boston, operating electric railways and an electric railway; and James F. McLaughlin, electrode for secondary batteries and electric locomotives.

The Westinghouse Electric Company have brought suit against the Frankford Merchants' Electric Light Company to recover $7,882.01 for a claim arising under a contract entered into between the parties, in pursuance of which the plaintiffs furnished defendants with material and labor used in the construction of an arc electric light plant in defendants' station in this city, consisting of dynamos, lamps, armature, etc., and work of construction.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, April 5, 1890.

The Salt Lake City electric lightning plant is to be doubled in capacity.

Petaluma's, Cal., Congregational Church has been supplied with incandescent lights.

The Verona, Texas, Electric Light, Water & Ice Company has been organized.

B. F. Draper, Ligonier, Ind., will add a Thomson-Houston 20 light arc machine to his plant.

Mr. R. R. Woods, McCook, Neb., is reported to have sold his electric light plant for $13,000.

Mr. W. J. Phelps, of Elmwood, Ill., was in the city this week arranging for additional material for his plant.

Mr. W. J. Floyd, formerly of Boston, is now connected with the Chicago office of the Excelsior Electric Company.

Denver, Colo.—It is reported that the firm of Albert Sechrist & Co., Denver, dealers in electrical goods, etc., has dissolved.

The California Electric Light Company, San Francisco, are being sued for a fancied injury to a neighboring dwelling on Jessie street.

The capacity of the Badger Electric Company, at Racine, Wis., has been increased by adding a Thomson-Houston 30-light arc machine.

A. H. Revell & Co. have adopted a Thomson-Houston 10 h. p. motor, which they will use for power purposes in the future in place of a gas engine.

Mr. L. W. Wolfe, Omaha, Neb., stopped over in Chicago this week en route to New York. Mr. Wolfe is purchasing a line of supplies for the spring trade.

Noyes Brothers, Chicago, manufacturers of electric light and combination fixtures, report large orders for their electric brackets, of which they make a specialty.

The Memphis, Tenn., Thomson-Houston Electric Light and Power Company has been succeeded by the Memphis Light and Power Company.

The National Electric Construction Company, Chicago, Ill., will install a 300-light Thomson-Houston incandescent dynamo in the new *Inter-Ocean* building.

The Electro-Depositing Company, of St. Louis, Mo., has been organized with a capital stock of $20,000. Incorporators, Theo. Plate, John Plate and A. Mohr.

The Westinghouse Electric Company, Pittsburgh, have secured the control of the Windsor-Wortz lightning arrester, said to be one of the most perfect yet devised.

Capt. Jas. D. Randall, manager of the Novelty Electric Company, Memphis, Tenn., has secured the agency of the Yost typewriter, and during the past 60 days sold 20 machines

Mr. J. F. Shawhan, electrician of the Storage Battery Motor Company, is operating his double armature motor with good success on one of the prominent street car lines in Detroit.

The Memphis, Tenn., Printing Company are successfully operating their presses with a Thomson-Houston motor, the necessary current being supplied by the local company.

The United Edison Company have opened an agency at 202 Griswold street, Detroit, Mich. Mr. Wm. M. Porter will be the manager, and his superintendent will be Mr. F. A. Carr.

The Dubuque, Iowa, Electric Railway Light and Power Company, of Boston, has given a deed of trust to the Bay State Trust Company, of this city, to secure $285,000 first mortgage bonds.

An Employment Bureau for the benefit of electrical companies is about to be opened in Chicago, where, for a nominal sum subscribers will be placed in communication with parties desiring employment.

American Electric Supply Company, at Chicago, has been organized to manufacture all kinds of electric apparatus; capital stock, $250,000; incorporators, F. E. Shaw, William Martin, W. O. Johnson.

Dr. E. A. Leake, of Collierville, Tenn., has kindly placed several of his special type of telephones in the hands of Leland Hume, manager of the Cumberland Telegraph and Telephone Company, Memphis, Tenn.

The Westinghouse Electric Company will move their lamp socket department, employing 125 hands, from Pittsburgh to Newark, N. J., and thus concentrate the manufacture of lamps in Newark and New York.

The Walworth Manufacturing Company, of Boston, have secured the contract for supplying all the needed poles in the long lines of electric circuits to be constructed in St. Paul and Minneapolis by the Minneapolis Electric Railway Company.

Mr. F. M. Farwell, of the railway department of the Northwest Electric Construction and Supply Company, St. Paul, is at Pullman, Ill., superintending the placing of the Thomson-Houston motors on the cars ordered by this company for its various roads.

J. J. Ryan & Co., Chicago, have been forced to double their floor space and capacity owing to the rapid increase in their brass foundry business, due largely to the perfect work turned out, as well as to the accommodating spirit always shown to customers.

The Rockford Electric Manufacturing Company, Rockford, Ill , have sold a 15 h. p. and a 7½ h. p. Mayo motor to the Chicago *Inter-Ocean* Company to operate their heavy presses, the current to be supplied from the W. L. Abbott central station in this city.

Little Rock, Ark.—The Little Rock Street Railway Company's 15 miles of track, two stables, 35 cars and over 200 head of stock have been sold to a St. Louis syndicate, of which Dick Kerens is the head, though it is given out that local parties are the purchasers. The price paid is between $300,000 and $400,000.

Mr. Minot Tirrell, superintendent of construction of the United Edison Company for the Southwestern section, was in town this week en route from New York to his headquarters in Dallas, Texas. During Mr. Tirrell's long residence in the West he won many friends who were glad to again meet him, and to learn of his continued prosperity.

Revival of Business.—Now that the local elections are over, it is expected that the councils in many of the smaller towns will settle down to business and grant franchises and other privileges that have been hanging fire and thereby vexing the soul of the hustling special agent of "the only good electric light apparatus on the market to-day, sir."

Board of Trade Wins.—Every telegraph wire and telegraph key has been removed from the floor of the board, and not even the tubes will be used hereafter, and the big space in the centre of the hall heretofore occupied by nearly 150 operators is now vacant. The change was made at the request of the directors, in the hope of closing the "bucket shops."

The Electrical Supply Company, Chicago, have issued a handsome pocket circular and price list of Habirshaw wires, cables and cores, for which they are exclusive agents, and they now have an immense stock on hand, they can fill orders of any size without delay. Mr. Terry will make the name "Habirshaw" a familiar one throughout the west.

Mr. La Fayette Cole, late secretary and manager of the Jenney Electric Light and Power Company, Peoria, Ill., has accepted the management of the Western office of Holmes, Booth & Hayden's, and will start on a flying trip among the stations before many days. Mr. Cole's extended acquaintance among central station men should render his services peculiarly valuable.

Mr. C. C. Warren, the general manager of the Leonard & Izard Company, Chicago, controlling the Edison interests in the Central States district, has closed 134 contracts for complete installations during the past six months, ranging in size from 5,000 down to 100 lights, which speaks volumes for his activity, as well as for the well-earned reputation of the Edison system.

Mr. H. P. Lucas, the jovial traveling representative, has severed his connection with the well-known firm of Holmes, Booth & Haydens, to accept the position of general manager of the supply department of the Northwestern Electric Construction and Supply Company at St. Paul, Minn., to date from April 1. All his friends wish him the utmost success in his new undertaking.

The Electrical Supply Company, Chicago, have laid in a heavy stock of Habirshaw rubber-covered wires, suitable for currents of high or low potential, for special feeder cables, for electric light switchboard cables, or electric light elevator cables. In addition, they are also carrying their usual full supply of Shield brand wires, which are valued so highly by all experienced contractors.

Incorporations. The Morrison Electric Light Company, at Morrison, Ill.; to furnish light, heat and power; capital stock, $25,000; incorporators, E. A. Smith, O. H. Brown and G. H. Brown. Highland Park Electric Light Company, at Highland Park, Ill.; to furnish light, heat and power; capital stock, $25,000, incorporators, B. E. Sunny and H. H. Small, Chicago, and B. H. Anderson.

The Keating Implement and Machine Company, of Dallas, Tex., have been appointed the representatives of the Abendroth & Root Manufacturing Company, of New York, in that city. They will handle more particularly the celebrated Root new water-tube boiler made by this firm, and have already issued a neat illustrated circular setting forth the merits of this popular steam generator.

The Sprague Electric Railway and Motor Company's Chicago office is sending out a handsomely-prepared circular showing a list of the electric street railways installed by the Sprague Company prior to 1890, summing up a total of 1,075 cars and 2,092 motors that are distributed in 76 cities Then, in addition, they report the sale of 810 railway motors during the first 60 days of the present year.

The Knapp Electrical Works, Chicago, are in receipt of another carload of Grimshaw white core wires and nearly a carload of Perkin's incandescent lamps, enabling them to keep up with the heavy demand that is never ending. Mr. Krupp is already arranging to hang a banner on the outer wall in 1892 that will attract the attention of visitors, whether hailing from Greenland's icy mountains, or floating in from India's coral strand

A Rare Occurrence.—The rarity with which electric light plants are offered for sale, owing to the profitable character of the investment when properly managed, should be a good criterion for judging of the value of the plant now placed on the market, owing to the removal of the owners, and to close an estate in Wisconsin. Contracts are in operation for 110 eleven o'clock arc lights and 20 city lights on moonlight schedule, and an excellent incandescent can be worked up if the purchaser desires to increase the plant.

The Thomson-Houston Electric Company have sold, through their Chicago office, 35 arc and 50 incandescent lights for use in the mills of the Illinois Steel Company at Bay View, Wis.; 35 arc lights to the Oakland Gas, Light, and Heat Company, Oakland, Cal ; a 300-light incandescent plant for the confectionery store of John Kranz, 80 State street, Chicago; and the Laredo Improvement Company have purchased two 50-light arc and two 650-light alternating current incandescent machines, which they will use in lighting the city of Laredo, Tex.

A Golden Wedding in Louisville.—Dr. and Mrs. Norvin Green this evening celebrated the fiftieth anniversary of their wedding at their elegant residence on the southwest corner of Second street and Broadway. The couple received the congratulations of their children and many friends and entertained them at their home. The reception, while elegant, was very quiet and the guests were confined to the relatives and close friends of the family. Dr. and Mrs Green received congratulatory telegrams from friends in all parts of the country. Dr. Green is well known as president of the Western Union.

Mr. J. A. Stephens, Muncie, Ind., has devised a new form of individual regulator for incandescent lamps that is attracting considerable attention owing to its compactness and simplicity. Mr. Stephens claims that his device overcomes all the bad features connected with the introduction of metallic or liquid resistance in the circuit, and that it may be used either to replace the resistance box controlling a large group of lights, or in the sockets of each individual lamp, thus permitting of separate regulation by a simple turn of the key. The device is a comparatively inexpensive one to manufacture and will probably meet with ready sale.

A Decided Attraction.—One of the largest retail houses in the city has a Detroit motor in one of its front windows that, driven by current from an Edison dynamo, in turn drives a coffee mill and a spice mill used in grinding coffee or spices purchased by the customers. Judging from the number of passers-by that stop and watch the machinery in operation it is as good a drawing card for the house as they could have, while the results actually secured by the Detroit Motor Company amount to no small sum. It's an excellent advertisement for both parties. Mr. W. S. Armour made the installation.

The Sheboygan Electric Company, of Sheboygan, Wis., have filed amended articles of corporation with the Secretary of State, increasing their capital stock to $50,000, and the company is now at work constructing additional circuits for the city lighting, two 50-light Thomson-Houston arc dynamos and 100 double carbon lamps having been purchased. The street lights will burn every night from sunset to sunrise. In all probability, at the next council meeting a franchise will be granted to the Heisler Electric Light Company, giving them the right to install and operate a plant, provided the wires running through the two principal streets are placed under ground.

The Western Electric Company, Chicago, have issued a catalogue of over sixty pages, giving an illustrated description of the "arc lighting systems of the Western Electric Company." Within heavy silver embossed lettered covers are handsome cuts of the various apparatus manufactured, and also of the devices that go to make up a thoroughly equipped station, including the Rudd

ground alarm and the Warner testing battery. There are also some excellent hints of value to contemplating purchasers, as well as various tables of value, etc. The handsome typographical work and the fine quality paper make the book worthy of a place in the library of the electrician.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$290@$295	Cumberland	$ 59@ $60
Central Union	58@ 59	Wisconsin	116@ 117
Michigan	96@ 98	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	23@ 25
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$93@$94	Chicago Edison Co	$113@$114

The Height of Buildings.—The action of the city council of Minneapolis, in decreeing that no licenses shall hereafter be issued for the erection of buildings over 100 feet in height, is not only an irrational piece of business, but will have a serious effect on the question of electric light installations. Just why the council did not order that all buildings hereafter erected above four stories should be of approved mill or fireproof construction is not easy to see. Anyway, it was not the height of the *Tribune* building that was responsible for the loss of life at the time it was destroyed by fire, which is the unbusiness-like excuse given for this unprecedented action, but it was due entirely to the faulty construction of what has since been truly termed a "fire trap."

Incorporations.—The Citizens' Electric Light Company, of Independence, Mo., has been organized by I. N. Rogers, W. A. Cunningham, W. S. McCoy and Chas. Gudgell. The Garrett Electric Light Company, of Garrett, Ind.; capital, $10,000; incorporators, F. W. Brandt, F. E. Davenport and W. H. McIntyre. Citizens' Electric Company, of Goshen, Ind.; capital stock, $3,000, in shares of $15 each; directors, Albert Gates, A. J. Irwin, O. M. Carter, Woodson Neassick, and H. Dombufsky. The Electric Light and Power Company, of Tomahawk, Wis., has been organized with a capital stock of $5,000 by Milo Woodburn, John W. Coon and O. B. Stewart. The Edward P. Allis Company of Milwaukee; capital stock, $1 500,000; incorporators, William W. Allis, Charles Allis and Edwin Reynolds.

Mr. George C. Bailey., Chicago, Western manager of the John A. Roebling's Sons Company, can lay good claim to having captured the heaviest order on record for electric conductors, having secured from the Minneapolis Street Railway Company and the St. Paul City Railway Company, for their extensive electric railway installations in both the cities of St. Paul and Minneapolis, the contracts for supplying nearly 100 miles of lead-incased heavy conductors for underground work, and the same amount of overhead feeders having weatherproof insulation, besides several carloads of bare copper wire. The total value amounts to some $250,000. Deliveries are to commence in May and continue till completion of contract, and requiring in the shipment a total of 75 cars, holding 40,000 lbs. each.

The Telegraph Companies of Chicago have declared that regular rates will hereafter be charged the members of the Board of Trade. This means an advance of 15 cents on messages to New York, and five cents to other cities. President Baker hints at the organization of a new telegraph company that will be friendly to the Board of Trade. The Board cleared the floor of the Exchange of all instruments on April 1, and it now says that this step of the telegraph companies is retaliation. On the other hand, the telegraph companies say the reduction of rates was in consequence of the facilities for handling messages that the location of machines on the floor afforded, and that the return to regular rates is only to indemnify them for the extra expense of handling caused by their removal.

The Storage Battery Motor Company, of Chicago, have had the well-known Ingraham car in operation on the tracks at Pullman for some weeks, and by their continued success have interested quite an amount of capital, and have also secured several good orders for storage cells. The car is propelled by current secured from 84 cells of the improved Detroit storage battery, having a capacity of 375 ampère hours. The track at Pullman is an unusually severe one for an experimental track, the length being three and one-half miles, with 22 sharp curves in that distance, two of which are of 27 feet radius. The car used is the same one that was illustrated in these pages in the issue of Feb. 23, 1889, when on trial at the Greenwood car stables in Brooklyn. Mr. A. A. Ingraham, the inventor, who has been stopping at the Palmer House for some time, has improved on the original device in having the same shafting carrying the friction wheel, also carry the armature, effecting an exceedingly economical transmission of power from motor to wheel solely by means of friction, doing away entirely with gearing of any character.

Mr. Clift Wise, chief engineer of the Minneapolis & St. Paul street railway system, was in town this week, en route to New York, where he will place the balance of the orders for supplies. In speaking of the contracts already let, Mr. Wise said: "These contracts were in every case awarded to the lowest bidder, and we know that the material when delivered will be of such durability and finish as to be satisfactory to the company and to the public. The material is first-class in every particular, and the names of the firms who have received the contracts are a sufficient guarantee of their excellence. Just where we will begin work I cannot say at present, but the necessary work on all of the lines will be completed well within the time fixed by the council." The Minneapolis *Journal*, in referring to the company, pays Mr. Wise the following compliment: Clift Wise, chief engineer of the Minneapolis and St. Paul street railway system, has already shown himself during the brief time in which he has been associated with the company to be one of the most able men in his profession, and is thoroughly deserving of the high tribute which was paid to his ability in his selection to fill the important office of chief engineer by Messrs. Lowry and Goodrich. The changes and improvements in the street railway service will be made under his direct supervision, and he will be kept busy until the work is completed. Mr. Wise leaves for New York Monday evening to award the contracts for the trolleys and the other accessories for the completion of the equal, if not the superior, of any electrical system in the world.

A. L. Ide & Son report the following sales of their Ide and Ideal engines: Medical and Surgical Sanitarium, Battle Creek Mich., one 25 h. p. Ideal engine (second order); Green, Kimble & Tallman, Vernon Centre, Minn., one 40-h. p. Ide engine; Thomson-Houston Electric Company, Chicago, one 80 h. p. Ideal engine; Springfield Woolen Mills, Springfield, Ill., one 50 h. p. Ideal engine; J. Kennard & Sons' Carpet Company, St. Louis, one 50 h. p. Ideal engine; Springfield (Ill.) Electric Light and Power Company, one 125 h. p. Ideal engine, one 125-h. p. Ideal compound engine; Bloomington Avenue Presbyterian Church, Minneapolis, one 35 h. p. Ideal engine; Fitzgerald Plaster Company, Springfield, Ill., one 65 h. p. Ide engine; J. T. Waterhouse, Cedar Rapids, Iowa., one 30 h. p. Ideal engine; College Park Electric Belt Line, Sherman, Tex., one 100 h. p. Ideal engine, boiler and fixtures; Forest City Electric Light Company, Rockford, Ill., one 150 h. p. Ideal engine; Moffett, Hodgkins & Clarke, Syracuse, N. Y. (second order) one 100 h. p. Ideal engine; English, Morse & Co., Kansas City, Mo., one 25 h. p Ideal engine, one 40 h. p. Ideal engine, two 50 h. p. Ide engines; Muscatine Gas and Electric Light and Power Company, Muscatine, Ia., one 65 h. p. Ideal engine; Jacksonville Gas Light and Coke Company, Jacksonville, Ill.; one 80 h. p. Ideal engine (third order); Carroll & Powell, St. Louis (second order), one 100 h. p. Ideal engine; Greenview Coal Company, Greenview, Ill., one 50 h. p. Ideal engine; W. J. Wilcox Lard and Refining Company, New York, one 50 h. p. Ideal engine; State Institute for Deaf and Dumb, Jacksonville, Ill., one 50 h. p. Ideal engine; Colorado Electric Supply and Motor Company, Denver, Colo., one 15 h. p. Ideal engine; Peter Schmidt, Milwaukee, one 80 h. p. Ideal engine; Detroit Electrical Works, for Street Railway at Fort Worth, Tex., two 150 h. p. Ideals; Kewanee Electric Light and Power Company, Kewanee, Ill., one 80 h. p. Ideal engine: United Edison Manufacturing Company, Denver, Colo.; two 35 h. p. Ideals for Ames Building, Omaha, Neb.

F. De L.

SOUTHERN NOTES.

Norfolk, Va., April 2.

The New Electric Lighting System has been completed at Concord, N. C.

The town of Shelby, N. C., is to be lighted up by 16 c. p. incandescent electric lights.

The Town of Maxton, N. C., is negotiating for the erection of an electric light plant for street illumination.

The Raleigh & Gaston Railroad Company will run a private telegraph wire between Raleigh and Welden.

Parties in Gadsden, Ala., are making efforts to organize a company to construct and operate an electric railway in that city.

The Riverside Land Company, of Norfolk, Va., will, it is reported, build an electric light plant to light the streets and drives of their property.

The question of the relative danger of electric lights and gas to public buildings is now being investigated by Governor McKinney, at Richmond, Va.

The town of Davidson College, N. C., is making investigation into the cost of electric street lighting, and will probably organize a company to erect a plant.

Superintendent Traylor, of the Richmond (Va.) Electric Street Railway, has invented an electric motor that possesses, it is said, a number of improved features.

D. W. Tompkins & Co., the electrical furnishers and engineers of Charlotte, N. C., have just finished placing electric lights in the Reidsville, N. C., cotton factory.

Work has commenced on the electric street railway system of Winston, Salem, N. C., for the construction of which the Sprague Company of New York have the contract.

The new buildings of the Bedford City, Va., Electric Light Company are about completed. The machinery will now be quickly put into position, and in a very short while the plant will be in operation.

The Western Union Telegraph Company is erecting a line from Danville to Portsmouth, in Virginia. The distance between the two cities is 220 miles, and the construction force is making about six miles a day.

The Gaynor Electric Company, of Louisville, Ky., contemplate establishing a general agency in the South for the handling of their fire alarm and police signal systems. Atlanta is the point selected for the branch office.

A corps of engineers has begun the work of surveying the route for the electric railway between Richmond and Petersburg, authorized under an act of the Virginia Legislature at its recent session.

The Norfolk & Western Railroad Company have put into their yards at Norfolk, Va., a dynamo capable of operating 26 arc lights, to illuminate the yards. An additional dynamo for lighting the company's offices and buildings is being put in, and another electric light plant will be built and equipped at the coaling yards of this company at Lambert's Point, near Norfolk.

The Burton Electric Heater for electric railway cars is being pushed to the front as a practical and efficient device for the purpose intended. The company has just issued a neat circular showing the application of the method. They report that three ampères current is quite sufficient for the effective heating of a car on a 450 volt circuit, so that it will be seen that the amount of current used does not seem great when the simplicity and convenience of the heating apparatus is taken into account.

The Citizens' Light, Heat and Power Company, of Portsmouth, Va., was organized last week, and the following officers were elected: R. M. Stuart-Wortley, of England, president; W. V. H. Williams, of Portsmouth, secretary; with a board of directors consisting of Judge L. Watts, A. D. Bateman, O. V. Smith and George L. Neville. The company will begin at once the erection of an electric plant for the purpose of furnishing light, heat and motive power. The works will probably cost $50,000. The company has received all necessary franchises from the city, and the contract for the erection of the buildings has been given out.

There promises to be an interesting legal contest between opposing electric street railway companies at Augusta, Ga. The new electric railway company announces its intention to construct lines on Broad street, now occupied by the old company, and the latter has notified the former not to do so. This will not deter the younger rival from entering that territory. The old company has offered to co-operate with the new-comers if they will only build on streets not now occupied by the older organization, but the latter says that if attempts are made to occupy the same streets they will take legal steps to prevent it. It is even intimated that other steps, more vigorous, will be taken, but this report is not credited. No response has been received from the new company to this pronunciamento, and it is said that they intend to prosecute their work without delay.

Y. N. B.

ENGLISH NOTES.

(*From Our Own Correspondent.*)

London, March 26, 1890.

Telegraph in India.—The report of the Indian department for the past year is of a very gratifying character. The surplus represents a dividend of 4¼ per cent. on capital expended. A principal feature of 1889 was the increase in the number of private messages, which went up from 1,860,000 to 2,815,000, the revenue from this source also increasing by about 15 per cent. The increase in the wire mileage was 6,137 miles. Some interesting particulars are given in the report with regard to the telegraph in the numerous miniature campaigns undertaken by the British army during the past twelve months. In the campaign known as the Sikhim expedition a telegraph office was opened at Bluedong, 15,500 feet, or 2¾ miles above the level of the sea. In the Hazara campaign ground wires for temporary communications were made with a success so marked as to call forth highest praise from the commander-in chief of the British army in India. It is interesting to note that of the total number of hours of delay during 1889, no less than 2,800 were caused by birds.

Electro-Magnetic Radiation.—This interesting phenomenon was the subject of a lecture delivered on Friday last at the Royal Institution by Prof. G. F. Fitzgerald. The professor opened his discourse by explaining the principle of resonance. He then pointed out the nature of the circumstances which determined the period of electrical oscillation by comparing them with the vibrations of a tuning fork. The vibration period of a tuning fork could be diminished either by increasing the stiffness of the prongs or by diminishing their mass. A small electrical capacity in a conductor corresponded to stiff prongs in the tuning fork, and small air space corresponded to a small mass in the prongs. The minute sparks crossing the gap in the resonator were made visible to the audience by connecting the air-space terminals to a delicate mirror galvanometer, which deflected whenever a spark occurred. The lecturer explained that it would not do to connect the terminals of the secondary circuit through the galvanometer direct, but that it was necessary to devise an arrangement in which a small subsidiary spark was given across an air space with its terminals connected in this manner. Experiments were then gone through showing how want of sychronism of the resonator with oscillations diminished sparking in the former. The lecturer then illustrated the principle of interference by communicating vibrations of large amplitude to the free end of a cord suspended from the roof, and he showed that the end of the cord or point of reflection was a node or point of rest. Similarly the point of reflection on an electro-magnetic wave was a node. This was shown by placing a sheet of metal immediately behind the resonator, which had previously been sparking under the influence of the oscillations, the result of placing the reflector close to the resonator being to cause the sparking to cease, showing that the resonator was then in a place of rest. The lecturer then observed that Clerk Maxwell had deduced from his electromagnetic theory of light that sunlight ought to repel any body which either absorbed or reflected it. That this was true for electro-magnetic radiation was shown by suspending a half-crown with a mirror attached to it in front of an electro magnet excited by an alternating current. The coin was then seen to be repelled whenever the current was turned on. A very striking experiment was next exhibited for the purpose of showing that electro-magnetic waves were polarized. A wooden frame, called by Prof. Fitzgerald "an electro-magnetic tourmaline," with a number of parallel wires, was interposed between two parabolic mirrors perpendicular to their common axial plane, and it was found that this framework would absorb electro-magnetic vibrations parallel to the wires, but not those at right angles. The professor concluded his lecture by exhibiting a beautiful experiment to show that the vortex in a liquid could be thrown into vibration exactly as if it were a solid. A tap was opened at the bottom of a large glass jar full of water and the whole mass of liquid was thrown into vibration about the vertical axis by stirring. A columnar vortex was thus formed extending from top to bottom, and was made visible by throwing some quinine into the liquid and illuminating it by the beam from an electric lantern. The jar was then shaken and a fluorescent vortex was seen to pulsate just like a solid, the waves traveling up and down between two surfaces of water from each of which they were reflected. The lecturer then suggested that ether might be supposed to be a liquid containing a number of vortices of this description, for Sir William Thomson had shown the possibility of the existence in a liquid of a considerable number of columnar vortices with their axes inclined at all possible angles. Vortex rings threaded through these vortices would represent material atoms. This theory would explain all phenomena in nature as being due to movements in space.

Institution of Electrical Engineers.—The reading of and discussion on Mr. Swinburne's paper on the "Theory of armature reaction in dynamos and motors," and Mr. Esson's paper on "Some points in dynamo and moter design," after having extended over five nights, concluded lastThursdsy evening. It may be safely said that no debate of equal practical importance has taken place at the Institution since that on Mr. Crompton's paper on "Central Station Lighting," of two years ago, I have already sent you abstracts of the papers themselves and must content myself with a glance at the discussion. One of the first speakers was Prof. Ayrton, who again brought up his theory of the essential difference of motor and dynamo design, although it is evident that he has somewhat altered the position he took up in his paper on "Electric motors and their design," which was read before the Society of Telegraph Engineers, in May, 1883. In this paper Prof. Ayrton stated that "in a motor then the armature should be by far the largest part of the machine—hence the armature must have 90 per cent, of the whole weight, and the field magnet only 10 per cent. When we consider, however, that the apparent resistance of a motor or dynamo due to self-induction is in proportion to the armature strength, we find that it is necessary to make the armature less in importance than might be assumed from the above investigation; and our own practical rule at present in the motor shown to the meeting consisted in making the field magnet about one-fourth the weight of the armature."

Apparently his contention now is merely that a relatively powerful armature strengthens the field of a motor and weakens that of a dynamo, a point about which there is no difference of opinion. Mr. Ravenshaw was inclined to throw some doubt on the practical value of Mr. Esson's formula.

$$A_2 = \frac{l\,r\,8{,}500}{w}$$

for the ampère turns that may be carried by an armature, and showed that this co-efficient varied in machines of his (Mr. Ravenshaw's) design from 40,000 to 200,000. Mr. Ravenshaw also disagreed with the contention that it was waste of time to endeavor to predetermine the magnitude of the stray field. Mr. Kapp was of opinion that the two papers under discussion would form very important epochs in the development of the dynamo. He suggested some further devices for measuring a symmetrical field, and was of opinion that both Mr. Esson and Mr. Ravenshaw loaded their machines too heavily. As a rough rule he found that the expression ampère turns on armature = 1,000 (d-5), where d = diameter of armature in inches agreed fairly well with his practice. Mr. Farquarson said the Admiralty rule for limiting rise of temperature had been misstated in Mr. Esson's paper; the rise permitted was 30 degrees Fahr. not 10 degrees Cent. Keeping in view the fact that these machines were run below the water line, in tropical climates, and sometimes for three weeks without stopping, he did not think the limit too low. Mr A. T. Snell remarked that he had always found the trail of a machine run as a motor to be less than its lead when run as a dynamo. Other differences of behavior

which he pointed out, also seemed to show that the magnetic distribution in generators and motors were not the same. He was of opinion that the field was more evenly distributed in motors than in dynamos. He had found the following expression of considerable use in estimating the output of a machine electrical horse power=$l\ d^2\ nk$, where l and d are the length and diameter of the amature, n the speed and k a constant. Professor Forbes said that non-mathematical readers should not accept unreservedly all the conclusions arrived at by Mr. Swinburne. As might be expected, Prof. Forbes did not agree with Mr. Esson's remarks as to the utility of stray field calculations. Mr. Mordey did not think that reversing pole pieces were likely to prove of much practical value, and was of opinion that sparking was best avoided by not overloading the machine. He also doubted the value of "smooth commutator dynamos" for high tension work. Mr. Mordey then made a vigorous attack on Prof. Ayrton and his theory of motor design, and contended that both in dynamos and motors, the armature which produced no appreciable field, was the best. Mr. Crompton referred to the many difficulties which cropped up in the design of large dynamos for central station work, and exhibited various specimens of sub-divided and twisted armature conductors now used by his firm with a view of diminishing the foucault currents in the armature conductors. Some doubt, he said, still existed as to the insulation of the driving hubs from the shaft; in his opinion it was not necessary. The question as to what material should be used in transmitting the driving strain from the shaft to the armature required careful consideration. He had found aluminum bronze and Delta metal fairly satisfactory. Mr. A. P. Trotter also disagreed with Mr. Esson's statements as to the non-utility and difficulty of stray field calculations, and said that since Prof. Forbes' formulæ had been published, the work of carrying out these calculations constituted part of the regular drawing office routine at Halifax. As to the accuracy attainable, the stray field in Messrs. Goolden & Co.'s M type of dynamo, where the leakage amounts to 60 per cent., it was pre-determined to within 1 per cent. by Mr. Ravenshaw. Mr. Trotter also exhibited some interesting diagrams completed by a novel method on the machine itself, which showed the direction of the waste field under various conditions of armature and field excitations. Mr. Stuart A. Russell described some interesting experiments on the subject of the difference in E. M. F. in a machine when run as a dynamo and a motor; the general result of his experiments may be summed up in a few words. Short circuiting of several coils of a motor greatly increased the E. M. F. of the motor, but did not strengthen the field in anything like the same proportion. Mr. Swinburne replied with considerable spirit and at great length, and had witty if not conclusive answers to the various and numerous criticisms to which his paper had been subjected. He said that as Sir William Thomson had made use of ergs in measuring magnetic potential, he thought he might be allowed to do so too. He stated several valid objections to the use of the term magnetic resistance, but offered as a name for the unit of magnetic resistence, the term "Gil," an abbreviation from Gilbert. He had no doubt that before long we should be quite at home in calculating out meg-gils and micro-gils. He was sorry that Mr. Mordey had not been able to make a shunt Brush machine work successfully for arc lighting. In his opinion four-pole drum machines would be used in future for large outputs.

The debate was then brought to a close by a brief reply from Mr. Esson, in the course of which he remarked that he would have been glad to learn something about the collecting of large currents, for this seemed to him one of the most difficult problems of the future.

The Lighting of the City.—This question was again discussed at great length yesterday by the Commission of Sewers. A strenuous attempt was made to repeat the time honored tactics of referring back. Finally, however, the report of the Streets Committee recommending that consent be given to several alterations in the contract with the Brush Company, and the Lang, Wharton, & Down Construction syndicate was agreed to by a large majority. The terms now obtained by these companies may be said to be of a very satisfactory character, and it would seem as if nothing now intervened between the city and the electric light which so many members of its municipal body do not want.

THE TELEGRAPH.

A new element is introduced into the postal telegraph scheme by the effort to secure Government patronage of the Esseck system of postal telegraph printing. The suggestion made is that the employment of a printing system of this description will very much lessen the force of employés necessary to take charge of the general telegraph business, thus enabling the Post Office Department to undertake a rather formidable task of doing the general telegraphing business without so much of an increase to the working force as would otherwise be necessary.

The St. Paul District Telegraph Company, have transferred everything to the American District Telegraph Company, of St. Paul, who propose to increase their facilities at once.

THE TELEPHONE.

The Tropical American Telephone Company is still further extending its business, and now has four branch storehouses from which they can make shipments to all points at short notice.

Telephone Rates.—At the meeting of the Council Judiciary Committee Corporation Counsel Darrow handed in an opinion denying the right of the city of Chicago to regulate telephone charges unless specially empowered to do so by the Legislature, which body, he claimed, had authority to vest the city with that power. The committee took no action on the opinion, but it was said afterward that the reduction of telephone rates was defeated.

THE ELECTRIC LIGHT.

The Carrollton, Mo., Light, Heat and Power Company succeeds the Carrollton Water Company.

Melrose.—The town of Melrose, Mass., is investigating the different light systems, with a view of establishing a municipal system.

Everett.—The town of Everett, Mass., has under consideration the erection of a municipal lighting plant. The present lighting is done by the Malden Electric Company.

The Carthage Light and Fuel Company, Carthage, Mo., has been duly incorporated by H. C. Messinger, of Carthage, and C. H. Martin, H. C. Martin and Geo. B. Campbell, of Fort Scott, Kan.

Melrose.—The electric light committee appointed at the last town meeting are busily at work pursuing their investigations. They appeared before the committee of the Legislature this week and are in hopes to secure such action as will cause the official opinion of the attorney general to be given as to whether towns have the right to establish electric light plants for public town purposes. Should this opinion be favorable, Melrose can have its electric plant established within a few months.

That the New South is quick to appreciate modern advances is shown by the report from Tallapoosa, Ga., which, although comparatively a small place, has its streets lighted with 50 c. p. incandescent lamps, by the Edison system. The company that furnish these lights began operations on Washington's Birthday, and have met with admirable success. They are soon expecting to increase the capacity of their plant, as their present dynamos are fully loaded and business is rapidly increasing. The plant is owned by the Vernon Light and Power Company, of which David Quackenbush is president and treasurer.

The Westinghouse Electric Company reports the following very good showing in central station business for the month of March, 1890:

Incandescent—Tampa, Fla., 500 lights, increase; Bluff Point, N. Y., 1,500; Kewanee, Ill., 750; Warren, O., 750; Rochester, Pa., 500; Shelby, N. C., 500; Methuen, Mass., 750; Nashville, Tenn., 3,000, increase; New York, N. Y., 1,500, increase (Mt. Morris Company); Canton, Mass., 750; New York, N. Y., 15,000, increase (United E. L. & P. Company); Hoquium, Wash., 750; Boston, Mass., 3,000, increase; Fort Collins, Colo., 750; Girard, Kan., 750; Auburn, Mo., 1,500, increase; Wilmerding, Pa., 1,500; total, 33,750 lights.

Arc—Warren, O., 105; Joliet, Ill., 35; Methuan, Mass., 40; Nashville, Tenn., 540; New York, N. Y., 125, increase; Hoquium, Wash., 50; Cumberland, Md., 45; Girard, Kan., 25; Boston, Mass., 125, increase; Harriman, Tenn., 60; Canton, Mass., 35; total, 1,215 lights.

At a meeting of the taxpayers of the village of Whitehead, N. Y., held March 26, it was decided to light the village by electric light, adopting 10 arc lamps of 1,200 c. p., and 72 incandescent lamps of 25 c. p. Two bids were under consideration, one from the Whitehall Gas Company for $2,635, and one from Frederick S. Dale as manager of the Whitehall Silk Company, for $2,200. The latter was adopted by a vote of 179 to 52.

The plant will be situated in the mill of the silk company, water being the motive power. The mill is already lighted by electric light, two dynamos of 400 16 c. p. lamps each and one of 250 16 c. p. lamps being used. Mr. Dale has already closed with the Thomson-Houston Company for one 45-light arc and one 650-light A. C. dynamo for the village lighting. Commercial lights will also be supplied. Two Hercules wheels of 130 h. p. each will be used, the water power of the dam being 700 h. p. The plant will be under the management of Mr. Dale, with Geo. M. Randall as electrician. The village lights will be turned on July 1, 1890.

The Westinghouse Electric Company has recently received an order for 750 Shallenberger meters of various sizes, which is the largest single order for these instruments that has come to the company since it placed the meters on the market. The order comes from across the Atlantic, having been placed by the Metropolitan Electric Supply Company of London, England, which several months ago decided to adopt the Westinghouse alternating current system for use in its large central stations in the great metropolis. Shortly after getting its first machinery started, the London company made a trial of the meters, and, being satisfied with the result, immediately ordered 350 of them. It has now seen fit to supplement the capacity of these 350 by an additional 750 meters, and when the latter order is received in London and put in use, 1100 meters of the Westinghouse manufacture will be employed there. The Westinghouse Electric Company is naturally more than a little pleased at this evidence of appreciation for their machinery on the part of the English company. The Metropolitan Electric Supply Company, by the way, first ordered 10,000 lights capacity in dynamos from the Westinghouse Company, and, about the 1st of February last, placed another order for the purpose of increasing its capacity to 25,000 16-candle power lamps.

Mauch Chunk, the capital of the American Alps, has just been provided with an electric light plant, and how much the citzens are elated over the innovation in the lighting of their streets can best be judged from the following article which appeared in the Mauch Chunk *Daily Times* of March 28:

"The streets of the Switzerland are now illuminated by electric light. The arc dynamo was run yesterday evening for the second time, and the forty lamps that are planted throughout the first and second wards, and East Mauch Chunk, shed forth their brilliant rays until quite a late hour, to the delight and pleasure of all our people, and to the evident satisfaction of the managers of the electric light company. 'Ain't they daisies,' 'It's a great success,' 'What a big improvement.' These and a whole column of similar expressions of praise could have been gathered from people on the streets who were watching the inauguration of the system.

"As has already been stated in these columns, the system used by the Mauch Chunk Electric Company is the Westinghouse. That company has evidently erected a plant here that may be rightly and justly esteemed to contain the highest attainment of the present day in electric lighting.

"This may be said of the incandescent plant which has now been in operation for some time and is also true of the arc plant, as was shown by the bright and steady rays from the street lamps yesterday evening and the evening before. It would seem as though the 'flickering' of the street lamp, and the wave from a bright light to a dimmer one, so usual to all other systems of street lighting, had been entirely overcome by the system adopted by the Mauch Chunk Company.

"We are informed by Mr. Jarrard, the superintendent of the Electric Light Company, that the street lamps and the wires throughout the town have all been put up at the company's own expense, and that the streets will be lit free of charge until April 1. The matter will then be presented to the Town Council for their adoption or rejection. As to what action that body will take we have no knowledge, but we do feel sure that the large majority of the citizens and taxpayers hope that the council will see its way clear for a speedy adoption."

APPLICATIONS OF POWER.

Establishing New Electric Roads.—The electric street railway franchise for a road between Athol and Orange has at last been settled and all the points are now practically agreed upon. The franchise grants the right to lay a single track from Athol to Orange, six miles in length, using the double trolley or any other satisfactory system, subject to a large number of conditions and restrictions.

The Mount Adams & Eden Park Electric Railway, Cincinnati, O., was started most successfully, and with no hitches of any kind, on March 22, by Mr. Elmer P. Morris, of the Thomson-Houston Electric Company, the present equipment of the road being four cars of this company's well-known system. The next day Sunday, the 23d, the traffic was very heavy, with no mishaps of any sort. Altogether a good record for a starter.

The City & Suburban Company, Memphis, Tenn., have consolidated the franchises of the Prospect Park, Magnolia & Jackson Mound Park lines, and the Thomson-Houston Electric Company is now constructing a power-house and line circuits prior to converting the roads into electric systems. The principal stockholders in the City & Suburban Company are: Napoleon Hill, Sam Tate, Jr., J. C. & H. M. Neely, George Arnold, T. F. Duffin & Bro., John Overton, C. N. Grosvenor, White & Norton and W. A. Gage.

The new electric locomotive, designed to tow as many as four cars, which has been for some time in course of construction at the Thomson-Houston Electric Works, was tried on Saturday on the Lynn tracks. It weighs seven tons, and the size of the wheels is 36 inches. It is run by two motors of 20 h. p. It has an air brake run by a 1 h. p. dynamo with a wheel. It runs easily 20 miles an hour. It has a fender much like the cowcatcher of a steam locomotive. It is designed for use on the West End Railroad, and will be shipped to Boston.

Victoria.—The street car business is booming. The cars now run every half hour, and from 12 noon to 2 p. m. every 20 minutes. The company intends to build at once to the band stand in Beacon Hill Park, and has also applied to the Provincial Government to guarantee interest at the rate of 5 per cent. on their bonds for $80,000 for the purpose of building a road to Esquimalt. Not content with this, it is contemplating a road to Saanich, on which freight as well as passenger cars would be run for the benefit of the farmers. Orders have also been placed for more cars and a 250 h. p. engine and 300 h. p. boiler.

An Old System Replaced at Allegheny, Pa.—The managers of the Federal Street and Pleasant Valley Street Railway, of Pittsburgh, Pa., which has been operating 25 motor cars on the Sprague Electric System for some time, are so well pleased with the operation of the cars on that road that they have ordered an additional equipment of 14 motor cars. Each of these cars will be equipped with two Sprague improved railway motors. This road now extends in the city of Allegheny, over the line of the early electric railway on University Hill, which used the Bently-Knight system with underground conduit, and was one of the first installed upon that system. The regular method of overhead contact is now used on this section of the road as well as upon the rest of the line, and the conduit has been abandoned. The grades surmounted by the electric cars, upon this road, are quite severe, being in one place about 12½ per cent., the length of the grade being over a mile. With the old electric equipment this grade was considered too steep to be ascended in the ordinary manner, and at the steepest part a rack was used between the tracks, in which a pinion connected with the motors engaged in order to secure the necessary traction. With the new equipment this arrangement is found to be unnecessary, and the Sprague cars have no difficulty in ascending the grade with the aid of no other traction than that which the wheels secure from the rails themselves. There are now ever thirty cars in regular operation upon this line.

PERSONALS.

Mr. Ralph L. Shainwald, president and general manager of the Standard Paint Company, started for San Francisco on Wednesday, April 2, in the interest of his company. Pond B. is constantly finding some new application, as it enjoys a good reputation as an insulating paint.

Dr. Philip Atkinson delivered his second lecture on electricity before the members of the Chicago Athenæum on Wednesday evening, his subject being "Cell and Battery Formation." A large and interested audience was present. Dr. Atkinson delivers the third lecture of the series on the subject of "Storage Batteries" on Wednesday evening, April 16.

MISCELLANEOUS NOTES.

Inspector McDevitt, of the Electrical Department of the Underwriters' Association, reports the following for the quarter ending March 31: Buildings examined that have been wired, 336; certificates issued, 237; incandescent lamps approved being an increase for the quarter, 2,717; arc lights, 25; motor horse power, 32. There have been no fires from the electric current during the past quarter.

The Cost of Fuel.—The chief engineer of a large electrical plant using over a thousand horse power in steam, says that an extended experience has shown that a horse power hour of steam may be secured from anthracite coal at one cent, and from bituminous coal at three-fourths of a cent. In other words, 1,000 horse power of steam can be secured for ten hours from anthracite coal at a cost of $100; this sum including every expense connected with the handling of both the coal and the ashes.

BUSINESS NOTICES.

The Western Electric Company has just issued a new catalogue of their incandescent apparatus, fully illustrated, and giving a very clear idea of the various devices used in their system. They are making an effort to push this branch of their business rather more than heretofore, and this catalogue will serve to call particular attention to the merits of their machine.

The Baxter Electric Motor Company, of Baltimore, is making rapid progress. The company possesses facilities for manufacturing that are second to none in this country, and the large number of orders received during the week for both arc and incandescent motors demonstrates that the Baxter motor still maintains its reputation as one of the foremost motors in the market.

OFFICE OF DAY'S KERITE WIRE AND CABLES,
16 Dey Street, New York.

TO WHOM IT MAY CONCERN: The relations of Edward B. McClees with the Kerite insulated wire and cable business heretofore carried on by A. G. Day have been terminated, and he has no authority to represent the undersigned or the estate of A. G. Day, deceased.

Dated New York, April 1, 1890. SARAH A. DAY,
Administratrix of the estate of A. G. Day, deceased.

CHICAGO ARC LIGHT AND POWER CO.,
76 Market Street, Chicago, March 22, 1890.

The Magnolia Anti-Friction Metal Co, 74 Cortlandt Street, New York:

GENTLEMEN: We have used your Magnolia Metal on dynamo bearings for the past eighteen months, and are very glad to state that we have found it serviceable and in every way satisfactory. We believe that it is superior to the other friction metals in market.

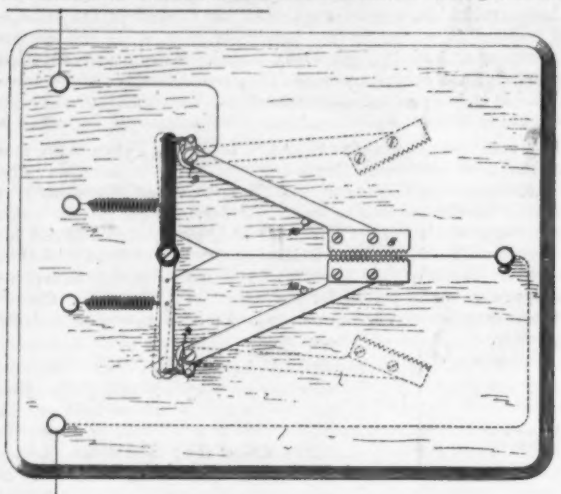
Yours truly,
(Signed) C. H. WILMERDING, Secretary.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED APRIL 1, 1890.

424,535. Electric Motor; Leo. Bock, Jr., Assignor by direct and mesne assignments to himself and Charles L. Wright, of same place. Application filed April 13, 1889. The combination with a reciprocating armature, of a series of solenoids acting thereon to cause its reciprocation, and circuit connections and contact devices whereby the direction of current in the solenoids is reversed, and the polarity of the armature thereby reversed during its reciprocation.

424,562. Lightning Arrester; Osborn P. Loomis, of Brooklyn, N. Y., Assignor to the Eureka Electric Company, of New York. Application filed Aug. 19, 1889. The invention consists in controlling the operation of arc rupturing means by the agency of a thermo-motive or thermostatic device that is arranged in such



No. 424,563.—Lightning Arrester.

a manner as to be made operative by the passage of a current over the arrester, and further, in such a device included in the circuit of the arrester.

424,563. Lightning Arrester; Osborn P. Loomis, of Brooklyn N. Y. Assignor to the Eureka Electric Company, of New York. Application filed Aug. 19, 1889. The invention consists in a lightning arrester having spaced discharge electrodes or plates relatively movable away from and toward each other, such means being controlled by the action of a thermo-motive or thermometric device actuated by the heat produced by the passage of a current over the arrester.

424,575. Electrical Insulation; Thomas S. Reed, of Jersey City, N. J. Application filed Dec, 5, 1888. The invention consists in first covering the wire or conductor with a layer of wool, cotton, or other soft textile fiber, by winding a loosely-twisted thread or yarn thereon spirally wound around the conductor, thus forming a soft or yielding cushion of peculiar character, over which the insulating layer of spun glass is applied, preferably by forming the spun glass into loosely-twisted strands or yarns, and applying the same under light tension around the pad or cushion.

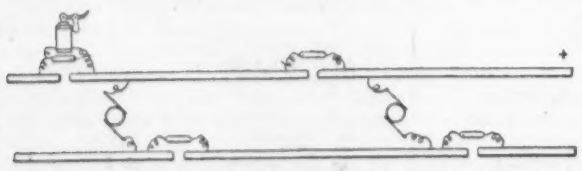
424,595. Regulation of Electric Motors; Sigmund Bergmann, of New York, N. Y., and George B. Scott, of Lakewood N. J. Application filed Nov. 23, 1889. The combination, with an electric motor, of a regulator consisting of arms pivoted in place at one end, a spring for drawing the same together, a projection from each arm together forming an expansible cylinder or wheel, and a lever or arm extending over the projections in the direction of the arms, and arranged in the electric circuit.

424,606. Choking Electro Magnet; Ludwig Gutmann, of Fort Wayne, Ind. Application filed Dec. 12, 1888. In a choking magnet the combination of multiple coils mounted upon a core hollow in the center, the said core enveloping the coils at all points except when the terminals of the coils are connected, and a second core movable within the first core, the said coils being adapted to be connected in consecutive order in series with one another and with suitable translating devices.

424,607. Method of Operating Electric Railways; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Boston, Mass. Application filed Oct. 10, 1889. The method of operating an electric railway, consisting in maintaining two or more electrically propelled cars in groups and coupled in multiple arc connections with each other, and two or more groups of cars coupled in series connection with each other, and shunting more or less of the current around the motor on each car of a group in accordance with the increase or decrease in the number of cars in the group to maintain the current passing through the motors, remaining normally constant.

424,635. Electric Call; Frank B. Wood, of New York, N. Y. Application filed June 22, 1888. The invention consists in the employment of two line wires, extending through all the sub-stations on the circuit, also in each sub-station ground or return connection for one of these wires. This ground connection is preferably made and broken by a step-by-step movement and a revolving arm attached thereto, so that as one sub-station is put into communication with the central office the preceding sub-station is cut out of circuit.

424,665. Safety Device for Electric Circuits; Charles G. Young, of New York, N. Y. Application filed Jan. 22, 1890. In a system of electrical distribution, the combination of an electrical generator, a main line in circuit therewith, a circuit breaking armature in circuit with the field magnet of the generator, and



No. 424,887.—Electric Railway.

automatic means for opening said circuit breaker upon rupture of the main line.

424,695. Suspended Switch and Traveling Contact for Electric Railways; Charles J. Van Depoele, of Lynn, Mass. Application filed Oct. 22, 1888. The invention consists in a track switch for the vehicle, a conductor switch for the contact device or "trolley" as it is termed, and the trolley itself attached to the vehicle, these elements being so arranged relatively to one another that in operation the vehicle reaches the track switch and is diverted laterally before the trolley reaches the conductor switch, whereby the trolley which partakes of the lateral movement of the vehicle has imparted to it a laterally moving tendency before its switch is reached, and it therefore passes through the switch in the proper direction, corresponding to the movement of the vehicle.

424,699. Electric Car Motor; Edward M. Bentley, of New York, N. Y. Application filed July 30, 1887. The method of reversing the direction of movement of mechanism, driven by an electric motor operating upon a constant potential circuit, which consists in disconnecting the mechanism from the motor, regulating the motor to prevent racing of the same, shifting the mechanical connections between the motor and driven mechanism, so that the relative directions of movement of the motor and driven mechanism will be reversed, and, finally, in reconnecting the motor with its load when the momentum of the driven mechanism has been reduced to a point where it will not overpower the motor.

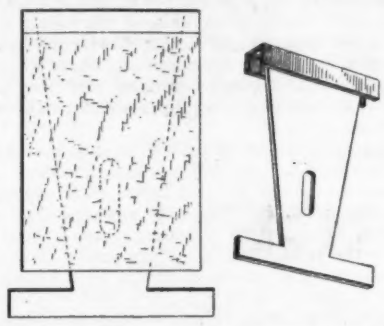
424,703. Electro Magnet; George D. Clarke, of Chicago, Ill. Application filed March 30, 1889. The invention consists in providing apertures in the heads of an electro magnet for the outer and inner ends of the wire coil. A circumferential groove communicates with one of the apertures in which is coiled a wire, one end of which is connected to the inner end of the magnet coil.

424,725. Electric Indicator; Major Dane Porter, of Newton, Mass., Assignor to the Porter Electric Messenger Company, of New York. Application filed Aug. 16, 1885. The combination at one station of an indicator capable of being set in any of several positions to transmit a desired signal, and an electro-magnet for returning it step by step to its normal position, a second indicator and an electro-magnet for moving it step by step into different positions at another station, an electric circuit, including the electro-magnets, a circuit controller at the last named station operated by the second magnet for temporarily interrupting the circuit at each movement of its indicator, and a circuit controller operated by the first named magnet to interrupt the circuit when its indicator is returned to its normal position.

424,726. Electric Indicator; Major Dane Porter, of Brooklyn, N. Y., Assignor to the Porter Electric Messenger Company, of New York. Application filed Oct. 17, 1885. The combination, with a series of variable signal transmitters, each having an indicator, a circuit controller, and a magnet of a receiver having a transmitter indicator, an automatically started signal indicator, and a rheotome, and an electric circuit between the transmitter and receiver, including the magnets of the former and the rheotome of the latter, the interruptions of the circuit by the rheotome causing the magnets of the transmitters to restore the indicators thereof and break the circuit.

424,729. Electric Trap; Francois Scherer, of Paris, France. Application filed Dec. 14, 1889. The invention consists of a lure to attract the creatures, arranged within or behind an enclosure or screen formed of a species of grid constructed of metallic rods or wires placed side by side, the wires forming parts of an open electric circuit, and when a body of an insect or other creature comes in contact with the grid it closes the circuit, thus killing it instantly.

424,734. Electric Motor; Lawrence T. Smith, of Providence, R. I. Application filed Dec. 26, 1888. An electric motor having the cores of the armature and field core composed of non-magnetic



No. 424.809.—Electrode for Secondary Batteries.

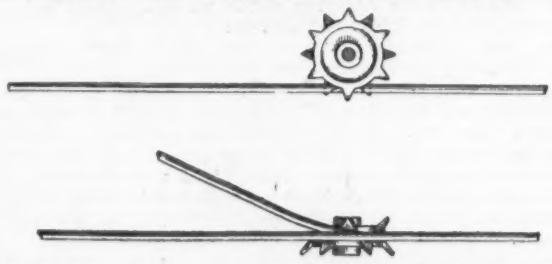
material, and having the winding of the drum armature arranged to form a closed coil, and further having the conductors arranged to receive at the same instant an alternating current of electricity produced from some external source.

424,739. Electric Switch; Charles S, Van Nuis, of New Brunswick, N. J. Application filed Sept. 28, 1889. In an electric switch, the combination of two pairs of spring plates each pair forming a circuit terminal, a forked metal blade whose extremities are arranged to enter between the pairs of plates, respectively, whereby circuit is completed through the blade, a spring for throwing the blade, and a handle for placing tension on the spring.

424,743. Fire-Extinguisher for Car Stoves; Samuel S. Weinberg, of Baltimore, Md Application filed Nov. 22, 1889. The combination of a car stove, a fire extinguisher below the stove having a glass receptacle, a pipe leading from the fire extinguisher to the bottom of the stove, a device to break the glass receptacle, and electro magnetic mechanism to operate the breaking device.

424,751. Electrical Conductor; John A. Barrett, of Brooklyn, N. Y. Application filed Nov. 6, 1889. The invention consists in an electrical conductor so covered with a fibrous or other separating medium as to afford in the covering numerous interstitial air spaces, around which is placed a non-conducting envelope capable of confining the air in such spaces and of retarding or preventing application of the sealing material from driving out the air originally inclosed within the insulating structure.

424,752. Arc Lamp; Ralph H. Beach, of St. Paul, Minn., Assignee to Charles F. Diether, Samuel B. Diether and Peter Ruenitz, all of same place. Application filed Aug. 12, 1889. The



No. 423,910.—Contact Device and Switch for Electric Railways.

compination of the lower carbon holder, a follower for depressing the upper carbon, guide rods on which the follower slides, a solenoid, a tube connecting the solenoid and the guide rods, and a spring for assisting in supporting the upper carbon holder.

424,786. Mangetic Pen Holder; Edwin A. Hill, of Reading, Pa Application filed Feb. 13, 1890. The invention consists of a pen holder of specially prepared steel, and by any suitable process magnetized so that it will become a permanent magnet.

424,809. Electrode for Secondary Battery; James F. McLaughlin, of Philadelphia, Pa. Application filed Dec. 19, 1889. An electrode for secondary batteries, consisting of a core having a ledge or seat formed at its lower end, and a block of active material surrounding the core and seated on the ledge, but otherwise bare, so that all but the bottom surface of the block is exposed to the electrolyte.

424,810. Electric Locomotive; James F. McLaughlin, of Philadelphia, Pa. Application filed Jan. 21, 1890. The combination of an electric motor and a clutch for connecting the armature of the same with the mechanism to be driven by the same, with a switch lever controlling the circuit of the motor, and mechanical connection between the lever and the clutch, whereby the motor circuit and clutch are controlled by the same lever.

424, 817. Boat; William H. Patton, of Chicago, Ill. Application filed August 12, 1889. The invention consists in the combination, in a boat, with the screw or analogous propelling means of mechanism for actuating the latter, comprising an electric motor operatively connected with the propelling means, a storage battery system connected with the motor to drive it, a dynamo electric machine for charging the battery, and an engine.

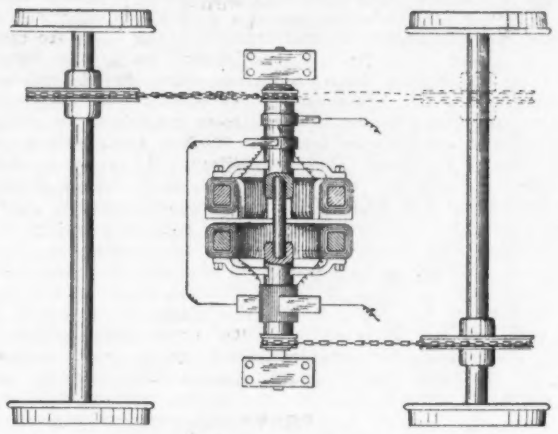
424,818. Electric Railway Motor; Frank A. Perret, of Brooklyn, N. Y., Assignor to the Elektron Manufacturing Company, of New York. Application filed Sept. 2, 1889. In an electrically propelled vehicle, the combination, with two axles thereof, of an electric motor having its armature and field magnets adapted to rotate in opposite directions, the said field magnet being geared to and arranged to communicate rotation to one axle, and the said armature being geared to and adapted to communicate rotation to the other axle.

424,827. Electro Medical Belt; William J. Shelton, of Columbia, Tex. Application filed Dec. 2, 1889. The invention consists in a belt or support constructed of multiple-ply electro-conductive belting, which I make by inserting a conductor or conductors between the folds of a multiple-ply band with suitable contact points at the surface, a sling supported by and movable on the belt for carrying the electric generator, also constructed of the electro-conductive belting.

424,845. Electric Railway; Edward M. Bentley, of New York, N. Y. Application filed July 30, 1887. In an electric railway, a common slotted inclosure and supply conductors belonging to distinct railway systems housed therein, the conductor of one system being supported from the wall and of the second system from the bottom of the conduit.

424,848. Electric Railway; Francis O. Blackwell, of New York, N. Y., Assignor to the Thomson-Houston Electric Railway Company, of Connecticut. Application filed Aug. 31, 1889. The combination of a surface electric railway with a series of posts located upon each side of the roadway, an elevated railway track carried on the said posts, and a supply conductor for the surface railways connected to transverse supports joining opposite pairs of posts.

424,860. Automatic Fire Alarm; Charles A. Cox and Joseph F. Cox, of Louisville, Ky. Application filed Oct. 11, 1889. The combination of an electric generator, an electro-magnet and its armature, a circuit connecting the magnet and the generator, two or more thermostats and alarm bells, each bell having a separate electrical connection leading to the main circuit, and each electric connection having separable contact points, a multiplex circuit closer, and a clock-work mechanism constructed and ar-



No, 424,818.—Electic Railway Motor.

ranged to make and break the circuit several times in succession to operate the alarm bells intermittently.

424,866. Arc Light; Julien Dulait, of Charleroi, Belgium. Application filed April 10, 1889. In an electric arc lamp, the combination, with screw nut and screw spindle, of regulating mechanism consisting of an electro-magnet on a shunt circuit of the lamp, a lever acted upon by the electro magnet and carrying at one end a contact screw and a spring, and at the other end the armature and knife edge, a crown escapement fixed on a spindle, carrying fly-wheel, a pinion also fixed on the spindle, and a toothed disc rigidly secured to screw spindle V, and gearing with the pinion.

424,888. Electric Railway; Walter H. Knight, of New York, N. Y. Application filed December 17, 1888 The combination, in an electric railway, of a bared supply-conductor connected to one pole of the source of electrical supply and a return in a circuit with the other pole, but electrically disconnected from the first named conductor except through the motors traveling over the railway, with a series of permanently located detecting devices, each operated upon a different section of the supply conductor to indicate the location of a fault thereupon.

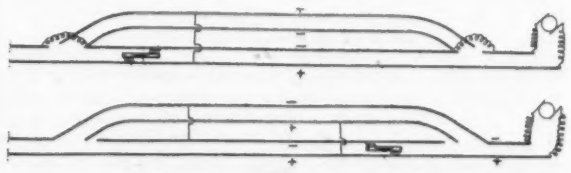
424,891. Method of, and Apparatus for Measuring Alternating Currents of Electricity; William Lowrie, Charles James Hall and Harold Werner Kolle, of London, County of Middlesex, England Application filed June 12, 1888. Patented in England Nov. 8, 1887; in France, June 28, 1888; in Belgium, June 28, 1888; and in Italy, December 31, 1888. The method of measuring the quantity of an alternating current of electricity passing over a given circuit, which consists in differentiating the current in opposite direction, and utilizing the differentiation to operate an electric meter.

424,921. Electrical Heater; John V. Capek, of New York, N. Y., Assignor to himself and Edward H. Johnson, of Greenwich, Conn. Application filed Oct. 26, 1889. In an electrical heater, the combination of thin electrical conducting strips secured together and facing one another, pieces of insulating material interposed between the strips at their ends, the middle portion of the strips being separated by air spaces, and electrical connections between the strips at alternate ends of the bundle, whereby all the strips are connected in series.

424,922. Electrical Cooking Stove; John V. Capek, of New York, N. Y., Assignor to himself and Edward H. Johnson, of Greenwich, Conn. Application filed Oct. 26, 1889. The combination, in an electrical cooking stove, of a casing, a movable electric heater located therein, an electric circuit, and means for maintaining the circuit in any position of the heater in the stove.

424,928. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Co., of Connecticut. Application filed Jan. 10, 1890. In an electric railway, the ordinary track rails of a main line and branching railway, in combination with an electric conductor extending along each of the tracks of the main line and branch, electrically connected with each other, but insulated from the rails, an electrically propelled car running upon the rails, and a laterally movable current collecting device carried by the car and making a moving contact with the conductors of either the main line or branch.

424,929. Double-Faced Electric Clock; Erick Wilh. Lindenau, of Joliet, Ill., Assignor to the Joliet Clock Manufacturing Company, of same place. Application filed Nov. 2, 1889. In an electric clock the combination with electro-magnets having the armature arranged to oscillate above but not in contact with the magnets, a pawl connected with one end of the armature and



No. 424,928.—Electric Ralway.

a coil spring for returning the pawl and armature when the circuit is broken.

424,935. Cable Grip; Edwin S. Reid, of New York, N. Y., Assignor to the Standard Underground Cable Company, of Pittsburg, Pa. Application filed January 11, 1890. In a cable grip or drawing-in apparatus, two or more sectional blocks or wedges adapted by their movements towards each other to take a bite on one or more cables to be drawn and made with an exterior taper, in combination with a surrounding shell or sleeve correspondingly tapered as regards its inner wall, and provided with engaging devices by which to make connection with the pulling power.

(1) 424,910. Contact Device and Switch for Electric Railways. (2) 424,911. Electric Railway Motor; Charles J. Van Depoele, of Lynn, Mass. Application filed (1) March 21, 1889. (2) October 25, 1889. In electric railways, the combination of a main conductor, a branch conductor united to and extending therefrom, and a self-switching contact device comprising a grooved wheel provided with notched edges. (2) A motor frame comprising side arms having bearings at one of their ends, whereby the same are sleeved upon the axle to be driven, bearings at the opposite ends for the armature shaft, a magnetic yoke connecting the arms and integral therewith and field magnet cores removably secured to and magnetically united by the yoke.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give date and number, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.

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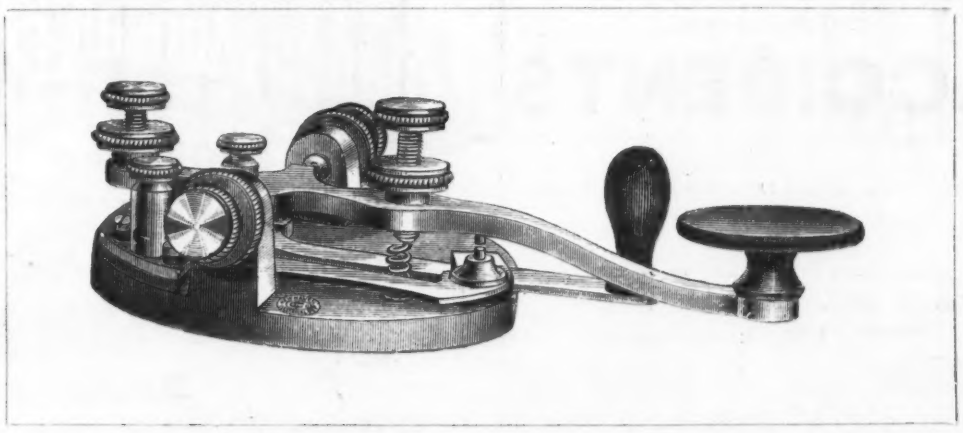

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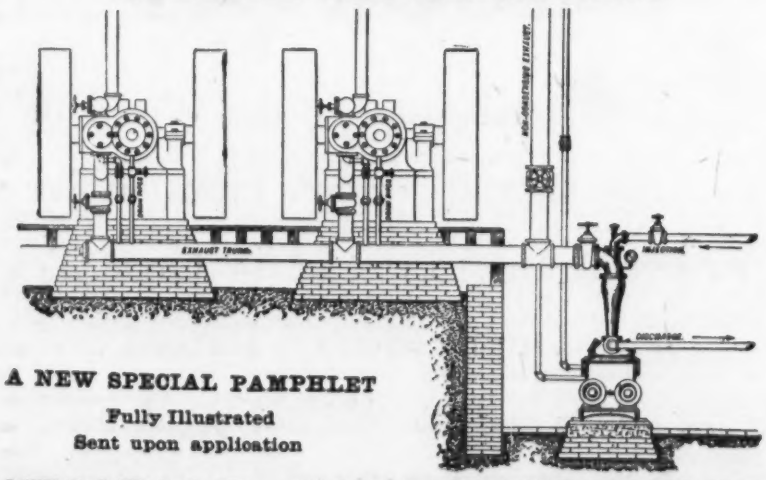

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